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INFORMATION CIRCULAR

CEMENT IN LATIN AMERICA

BY

OLIVER BOWLES AND A. TAEVES

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

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by Oliver Bowles[2] and A. Taeves[3]

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7360."

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INTRODUCTION

In 1940 the Bureau of Mines issued a report[4] describing all the cement plants of Latin America, their design, capacity, and output, and the cement imports, exports, and requirements of the several countries. Since that time there has been such great activity in cement-plant construction that a revision of the paper is highly desirable. The present compilation comprises the essential data in the previous report together with descriptions of all cement plants completed, under construction, or planned since that date and an over-all picture of the supply and requirement situation of each country.

Before World War I, Latin America was one of the world's largest export markets for cement. Its dependence on outside sources created no special problems of supply until the shortage of shipping and abnormally high prices of the First World War stimulated a movement toward greater self-sufficiency. Under this incentive many cement plants were constructed, and several countries were able by 1939 to manufacture enough cement for their modest needs. Substantial imports were still required for many important areas, and as the volume of demand was rapidly increasing the Latin American countries as a whole were far from self-sufficient in cement when the Second World War began. South and Central America depended to a large extent on European countries, chiefly Germany and Belgium, and to a smaller degree Scandinavia, United Kingdom, France, and Italy, to supply their cement shortages. The cost of manufacture in these European countries was much lower than in the United States, and transportation expense had been kept at a particularly low level because of the two-way trade that had been developed. Ships destined for Latin American ports for coffee, tropical woods, fruits, and other native products could carry cargoes of cement on their westward voyages at very low cost. In some instances cement was taken in exchange for South American products because cash was not available. Great Britain had withdrawn from this market to quite an extent because of low prices and because trade with its own Empire had been increasingly fostered. United States trade in cement with Latin America had been confined principally to white and other special varieties. In few places could ordinary portland cement made in the United States compete in price with the European products, although in general it was of better quality and could be delivered more promptly.

It may readily be seen that such conditions created a very serious situation in Latin America when the outbreak of the Second World War suddenly paralyzed trans-Atlantic shipping. To seek supplies in the United States was futile because the Caribbean and coastal waters were just as hazardous as the broad Atlantic. The stringency of cement supply could only be overcome by domestic manufacture. Under this strong incentive active measures were taken to create or enlarge cement industries in many countries. To point out the essentials of these rapidly expanding developments is the purpose of this report.

Industrialization of Latin American countries, which has made slow progress, has been accelerated during the war years. The harvesting of one or two agricultural commodities or the mining of a few marketable minerals is being supplemented by development of an integrated industrial economy. As industrialization gains impetus an increasing market for cement is a natural consequence. This is evident from the fact that industrialization is linked with increasing transportation, and means of transportation are very poor in much of Latin America. Bridges, culverts, and concrete highways, now scattered sparingly throughout the vast land areas south of the United States, must multiply as the demands of industry increase and as a higher scale of living is attained. Eventually the South American countries will be linked by modern highways. Considerable progress has been made with the great Pan American Highway. Furthermore, the arid climate of many regions creates a demand for construction of dams and irrigation works, and a continent poor in coal reserves but with abundant water power inevitably must direct its energies toward the construction of hydroelectric power plants. Countries rich in raw materials but with few natural harbors have urgent need of massive concrete breakwaters and docks. The demand for concrete in houses will also grow. Standards of living are low, and perishable building materials are widely used. As living conditions improve cement will be used increasingly in home construction. Even in the field of simple and modest housing cement affords a means of creating low-priced verminproof and fireproof homes, for which the need is imperative under climatic conditions that prevail in this area of the world. Already many of the countries have undertaken extensive public works, and such programs are likely to increase. With stable governments, peaceful international relations, and increasing industrial activity, a substantial growth in the demand for cement in this vast southern area may be anticipated.

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[4] Bowles, Oliver and Miller, R. B., The Cement Industry of Latin America: Bureau of Mines Inf. Circ. 7102, 1940, 38 pp.

The following table presents concisely the condition of the cement industry throughout Latin America according to the most recent available information. For comparison, United States figures are added at the bottom of the table. It may be observed that the growth of the cement industry has been relatively modest in the Latin American countries compared with its phenomenal development in the United States.

Salient statistics of the cement industry of Latin America[1]

Country	Plants operating	Plants under construction, 1945	Production (metric tons)	Consumption (metric tons)	Per capita consumption, bbl. (376 lb.)
Mexico.......	13	4	578,253	637,567	0.19
Argentina....	11	1	957,076	946,663	.43
Bolivia......	1	0	134,382	138,333	.24
Brazil.......	8	0	747,409	763,489	.10
Chile........	2	0	374,747	381,837	.48
Columbia.....	[2] 7	1	226,304	224,825	.15
Ecuador......	1	0	27,860	28,809	.06
Paraguay.....	[3] 1	0	-	[4] 7,964	.05
Peru.........	1	0	208,599	202,376	.18
Uruguay......	2	0	[4] 179,066	[4] 181,613	.51
Venezuela....	4	3	111,721	170,185	.21
Guatemala....	1	0	([5])	([5])	-
Cuba.........	1	0	169,609	173,095	.25
Puerto Rico..	2	0	167,591	159,108	.50
Total	55	[6] 10	3,882,617	4,015,864	[7] 0.21
United States	153	0	23,067,914	21,802,110	0.93

[1] Data on production and consumption are for 1943 unless otherwise designated.

[2] Production reported for 5 plants; the other 2, although said to have been completed, have reported no output.

[3] Inactive.

[4] 1941.

[5] Data not available.

[6] The additional unit is the plant reported under construction in the Dominican Republic in 1945.

[7] Producing countries only.

The cement industry is covered by countries in the following pages. The data include availability of raw materials, descriptions of plants, plant capacity, production and consumption for a series of years, and per capita consumption. Imports and exports of cement are recorded, and fluctuations in sources of supply are traced. Consideration is also given to the degree of self-sufficiency of each country and general conditions controlling present and future markets.

MEXICO

Mexico during recent years has been rapidly industrialized. This development has been accompanied by a marked migration of its urban population to the cities. The Government has fostered industrial activities by encouraging or assisting road building, construction of hydroelectric power plants, and extension of water and sewage facilities. It has aided agriculture by promoting irrigation projects. There is also widespread demand for dwellings, hospitals, and schools. These various enterprises, coupled with war activities, have created a building boom.

The demand for cement for these numerous projects has far exceeded the local supply. Cement shortages became so acute in 1943 that a decree was enacted establishing a priority system whereby 50 percent of the cement was reserved for Government use,the other 50 percent being allocated according to the essentiality of civilian needs. Steps were also taken to encourage larger imports from the United States. According to a reciprocal agreement between the United States and Mexico, concluded December 23, 1942, the Mexican import duty on Roman or portland cement was continued at the old rate of 0.02 peso per gross kilogram. However, early in 1944 the import duty on United States cement was suspended until domestic plants were able to supply the requirements and conditions for distribution returned to normal.

The urgent need for a larger domestic cement industry became more and more apparent as demands for cement increased in many areas. The movement toward greater self-sufficiency was accelerated somewhat in 1943 through creation in May of that year of a United States-Mexican Commission for Economic Cooperation. The development program planned called for erection of new plants or extension of existing plants to eventually make each of the five zones - northwest, north, central, Gulf, and south - produce its own requirements. Toward the end of 1945 considerable progress had been made in that direction.

Plants have been enlarged and new plants built to meet the growing requirements. In all, 13 cement plants were in operation and 4 under construction late in 1945, whereas in 1939 only 7 plants were in operation and 1 under construction. The building or enlargement of plants under war conditions has been very difficult. New equipment was almost unobtainable. Used machinery had to be secured from numerous points, some in Mexico and Canada, but chiefly in the United States, principally from abandoned plants. Such makeshift equipment had to be fitted together to best advantage; and, although the resulting plants are by no means the acme of efficiency, the companies have for the most part accomplished remarkable results under most trying conditions. One writer refers to the Mexican cement plants of the 1943-45 era as "miracles of improvisation". Undoubtedly when new equipment is again available modernization will be undertaken.

Although cement-plant capacity has been increased greatly, production is curtailed at times by shortages of transportation equipment, fuel oil, and hydroelectric power. The use of waste-heat boilers has overcome the latter shortage to some extent. It is claimed that present plants are equipped to produce 39 percent of their total power requirements.

Because of the Mexican Government policy to restrict foreign capital to 49 percent of the ownership of industrial plants, together with a growing confidence of Mexicans in their own industries, the cement industry is now largely Mexican-owned.

Following are brief descriptions of the cement plants of Mexico. More detail is available in a recent comprehensive survey by Trauffer.[5]

1. Cementos Hidalgo S.C.L. Hidalgo (Nuevo Leon). The plant, situated about 30 miles northwest of Monterrey, which began operation in 1903, marked the beginning of the cement industry in Mexico. In 1931 the company was merged with Cementos Portland Monterrey, S.A., to form Cementos Mexicanos, but the plant was closed in 1930. Thereafter, under Government sponsorship, it was taken over by a group of cooperative workers who still operate it. The original capacity of the plant, which has not been changed, was 150 metric tons (880 barrels) of standard portland cement a day. The equipment consists of four 7- by 100-foot kilns with four rotary coolers. The stone quarried near the plant is first reduced in a gyratory crusher, dried, then further reduced in hammer mills, ball mills, and tube mills. Clinker grinding is accomplished in two stages in tube mills.

2. Cementos Mexicanos, S.A., Monterrey (Nuevo Leon). This plant began operation in 1921 under the management of Cementos Portland Monterrey, S.A. It had a single kiln, with a daily capacity of 175 metric tons (1,025 barrels). In 1931, under present management, a second kiln was added, which doubled its capacity, and in 1945 a third kiln was being added, which will increase the capacity to 630 metric tons (3,700 barrels) daily, making it the second-largest plant in Mexico. The third kiln originated in the dismantled Aetna Portland Cement Co. plant at Fenton, Mich. The two kilns now in operation are each 9 by 120 feet, and the one in process of installation is 10 by 175 feet.

In addition to a standard brand the company also makes white, low-heat, and modified portland cements. Pure limestone and white clay are used in making the white cement. For brands other than white, the principal raw material is a conglomerate limestone obtained about 1 kilometer from the plant. It is reduced in a jaw crusher, followed by a cone crusher. The dried material is crushed to smaller sizes and is then pulverized in two-compartment pebble mills and sized with air separators and vibrating screens. The pure limestone is purchased from a quarry about 6 miles from the plant. Twenty to 30 percent of the pure stone is added to the limestone conglomerate for making the white cement.

Clinker grinding is accomplished in ball and tube mills followed by vibrating screens. All power for the plant is purchased, but a 17,500-kw. steam-driven generating plant was under construction in 1945.

3. Cooperative Manufacturera de Cemento Portland S.C.L. "La Cruz Azul", Jasso (Hidalgo). The plant now operated by this company was built in 1910 and was operated until 1932 by La Cruz Azul Compañia Manufacturera de Cemento Portland, S.A. At that time it was taken over by Cementos de Mixcoac, S.A. (also known as Compañia de Cemento-Portland, S.A.). As it was understood

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[5] Trauffer, W. E., Mexican Cement Industry Has Doubled Its Producing Capacity Since 1942: Pit and Quarry, vol. 36, No. 1, July 1945, pp. 99-115.

that the plant was to be shut down after its transfer, the workers, with financial assistance from the State, purchased it and operated it under the name given at the head of this paragraph.

The raw materials, limestone and shale, are quarried near the plant. After crushing in two stages the rock is ground in tube and compartment mills. Calcining is done in two 8- by 135-foot and one 8- by 150-foot kilns. The clinker is ground in pebble mills. There have been few changes since the mill was built except the addition of grinding mills many years ago. The mill has a daily capacity of 240 metric tons (1,400 barrels).

4. La Tolteca Cia de Cemento Portland, S. A., Tolteca (Hidalgo). The company operating under this designation is owned by a British concern, Associated Portland Cement Manufacturers, Ltd. The plant was built in 1916 by the Louisville Cement Co., who sold it later to the Gibbs Portland Cement Co. of England. In 1921 it was purchased by the present owners. The original 8- by 135-foot kiln was supplemented a few years later by a second kiln 10 feet in diametor and 150 feet long. A third kiln 8 by 125 feet was added in 1927, and a fourth, 9 and 10 by 170 feet, in 1942. The plant has a capacity of 440 metric tons (2,580 barrels) a day and was the second-largest producer in Mexico early in 1945.

The limestone is hand-loaded in a quarry about 3 miles from the plant, and clay is obtained from a convenient location. The rock is passed through a primary gyratory crusher and a secondary set of rolls. After drying it is pulverized in four tube mills.

The kilns are equipped with waste-heat boilers which supply steam for a 1,100-kw. turbogenerator. It supplies about half of the power needed, and the other half is purchased from the Mexican Light & Power Co.

5. Cementos de Mixcoac, S.A., San Pedro de Los Pinos (D.F.). A few years ago this company was known as Compania de Cemento Portland, S.A. It is owned by Associated Portland Cement Manufacturers, Ltd., of England, which also owns the Tolteca plant. Construction of the original one-kiln dry-process plant was begun at San Pedro de Los Pinas, a suburb of Mexico City, in 1931, and production was begun in 1932. The original kiln is a 9- by 10- by 285-foot unit followed by an 8- by 80-foot rotary cooler. The second kiln added in 1940 is a Lepol unit equipped with a 90-foot rotary section and a 2.3- by 10-meter grate followed by a rotary cooler. In 1944 a third kiln, 9-1/2 and 11 feet in diameter and 300 feet long, was added. It is followed by a 4-1/2- by 60-foot grate cooler. All the kilns have induced draft and are fully instrumented. All kilns have Cottrell dust-collecting units, which are being supplemented by bag collectors. The plant, with a capacity of 750 metric tons (4,400 barrels), a day is the largest in Mexico.

Limestone is conveyed by rail 40 miles from Tolteca quarry. A second important raw material - tepetate (volcanic clay) - is obtained from a deposit near the plant. The stone is reduced by a primary jaw crusher, sized with vibrating screens, and further reduced in a hammer mill. Moisture is removed in waste-heat driers. The dried material is ground to dust in pulverizers equipped with air separators. Clinker is ground with pebble mills in closed circuit with air separators. Both pulverized raw materials and finished cement are carried in Fuller-Kinyon conveying systems. Masonry cements are also manufactured.

6. Cementos Atoyac, S.A.; Puebla (Puebla). This name has been used only since 1934. The original company, Compañia de Cemento Portland Landa, S.A., began operation in August 1921 and produced about 300 barrels daily. Both Mexican and United States capital was employed. The original kiln is said to have been 6 feet in diameter and 60 feet long. In 1928 a 6- by 133-foot kiln was installed, and the original kiln was lengthened to 133 feet. Somewhat different dimensions for the earlier kilns are recorded by some writers. The present plant capacity is 400 tons (2,340 barrels) per day.

The original raw material was a cement rock similar to that quarried in the Lehigh Valley of Pennsylvania, but by 1930 the deposit was worked out, and a high-calcium limestone quarry was developed about 2 miles from the plant. The stone is hauled to the plant in 12-yard side-dump cars by electric trolley. The hammermill primary crusher operates in closed circuit with vibrating screens. The gyratory crusher originally used is held in reserve. Moisture is removed in an 8- by 75-foot waste-heat rotary drier. Clay is added and pulverization is accomplished in ball and tube mills. Clinker to which 2 percent gypsum is added is ground in ball and tube mills.

Before 1933 portland cement was made, but since that date three special cements, "Atoyac," "Plastocement," and "Caloyac," became of increasing importance and portland cement manufacture was discontinued in 1937. The second and third types mentioned are masonry and stucco cements. They are made by calcining siliceous limestones at relatively low heat. They evidently form an impure lime which is hydrated, and during hydration reactions take place between the lime and the silica and alumina. The product grinds easily.

In 1941 the company acquired a small, wet-process cement mill situated near the Atoyac plant. It had been operated by Cementos Indio, S.A., utilizing a marl bed that had been worked out. The plant had been idle for some years. The new owner reopened it, using stone from the Atoyac quarry, and adapted it to the manufacture of "Caloyac," formerly made in the main plant.

7. Cementos Portland Nacional, S.A., Hermosillo (Sonora). Construction of the Hermosillo plant in the far northwestern corner of Mexico was begun in 1930, and production was recorded in 1931. Both limestone and clay are obtained close at hand. The plant was built by a United States company, and all the machinery was made in the United States. It is the only wet-process plant in Mexico. The original kiln is 8 by 150 feet and was said in early days to have a capacity of 500 barrels a day. However, more recent writers state that its capacity was 120 metric tons (700 barrels) per day.

The demands for cement in the market area reached by this plant were quite limited in the early years of its existence. Accordingly, plans were made to dismantle and remove it to Mazatlan (Sinaloa), where much better transportation facilities are available, but the company was unable to finance the move. The plant operated at only 15 percent of capacity in 1935 and was idle in 1936. However, the plant acquired a new lease on life in 1938 when construction of the Yaqui Dam was begun. This project gave the company an order for 300,000 barrels of low-heat cement. This is the first plant in Mexico to manufacture low-heat cement in quantity. Ordinary commercial demands for cement have also increased in this territory.

As the plant is situated in the basin of a large power and irrigation project, it is being moved to a new location at Government expense. The hydroelectric current provided by the new dam will solve company power problems. The move will also place the mill nearer the glory-hole quarry from which the rock is obtained. Plans are being made to employ a 2,000-foot belt conveyor to carry the limestone from quarry to mill. In the rebuilt mill the 150-foot kiln will be extended to a length of 290 feet, thus increasing the mill capacity to 250 metric tons (1,465 barrels) daily.

The original two-compartment raw and finishing mills will be increased from two to four, and a grate-type cooler will be used. A Fuller-Kinyon conveying system will be installed.

8. Cia Mexicanos de Cemento Portland "Apasco" Apasco (Hidalgo). Construction of a plant with German and Swedish machinery was begun in 1930 at Apasco close to the border of the Provinces of Hidalgo and Mexico, but work was suspended for several years. The company was reorganized in 1935; and, with federal assistance in the form of a loan, steps were taken to complete it. The original kiln of Krupp manufacture, which began operation in 1938, was 6-1/2 and 8 by 140 feet and had a capacity of 100 metric tons (590 barrels) per day. A second kiln of United States manufacture (8 by 145 feet) which was added in 1943 doubled the plant capacity.

The principal limestone supply is from a quarry on a hill near the plant. As the quarry floor is 150 feet above the mill level, a balanced-skip inclined gravity-transportation system is used. A second quarry furnishing stone with a higher iron content is now worked, and the stone from both quarries is blended to make a better-quality, faster-setting cement. Clay is obtained from a pit 1 mile from the mill. Primary reduction is accomplished with two hammer mills, which are followed by two 6- by 35-foot rotary driers, one of which uses waste heat. The dried stone is further reduced with five hammer mills and three tube mills.

Clinker discharged from the kilns is carried by belt conveyor to a 6,000-ton storage building. The clinker is ground to finished cement in two tube mills. A 1,000-kw. turbogenerator furnishes about half of the power required. The remainder of the power is purchased, but purchase of a second turbogenerator is planned.

9. Impulsora de Cementos, S.A., La Junta (Jalisco). This plant was built by Cementos Guadalajara, S.A., but was purchased by the present owners shortly after it was completed. It began operation in 1943 at La Junta about 5 miles northeast of Guadalajara. The need for a cement plant in this area had long been felt, particularly for the city of Guadalajara, which was

rated as the fourth city of Mexico in volume of cement consumption. Freight charges from the nearest plants were so high that a nearby source was highly desirable, but establishment of a new plant had been discouraged by the absence of a suitable supply of limestone. All limestone deposits adjacent to Guadalajara were small and variable in composition. A limestone deposit large enough and of satisfactory composition was purchased at Huescalapa 103 miles from the plant.

The mill location was chosen because of its nearness to the city of Guadalajara and because clay materials and abundant water supplies were readily available. Original plans called for two 6- by 120-foot kilns, but a third kiln 7- by 135-foot was added. The products desired were portland-puzzolan and masonry cements. In June 1943 the first of the small kilns began operation producing lime which was needed for the puzzolanic cement. In July the second small kiln and in December the larger kiln began producing cement clinker. The two smaller kilns have a common stack 120 feet high, and the larger kiln has a separate stack. They furnish adequate natural draft.

Limestone is hauled over the national railways by a company-owned locomotive and cars. The argillaceous and siliceous raw materials consist of clay and a soft, easily quarried volcanic lava known locally as "jal," both of which are close to the plant. Gypsum is obtainable from the nearby state of Colima.

The primary crusher is a hammer mill. The mixture of crushed limestone and other raw materials is passed through an oil-fired rotary drier. Preliminary grinding is accomplished in a Bonnot mill, and final grinding in tube mills. Clinker is ground first in a conical mill and finished in tube mills.

The puzzolanic cement is made by mixing lime with "jal," hydrating, and grinding with cement clinker mixed in the proportion 30 percent lime-jal to 70 percent cement clinker. The resulting portland-puzzolan cement is manufactured to conform with Mexican specifications. Mortar cement is also made. The plant is designed to produce 200 metric tons (1,170 barrels) daily, but production is far below that level, partly because the equipment used was second-hand, picked up wherever available, and in part due to transportation difficulties in conveying both stone and fuel oil. Further detail is given in the technical press.[6]

10. Cooperativa Manufacturera de Cemento Portland "La Cruz Azul" Lagunas (Oaxaca). This company, which operates the Jasso plant already described completed and began operation of the new Lagunas plant late in 1944. The 178-1/2-foot kiln was assembled from kiln and cooler sections obtained at the Jasso plant, supplemented by some new sections. Its diameter ranges from 6 to 8 feet. It is completely instrumented, and a 180-foot stack gives it adequate natural draft. Its capacity is 80 metric tons (470 barrels) of standard portland cement per day. Raw materials are available nearby. The limestone quarry

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[6] Pit and Quarry, Plant of Cementos Guadalajara, Mexico's Newest Cement Producer; vol. 37, No. 1, July 1944; pp. 71-72, 103.

is 700 feet and the shale deposit less than half a mile from the mill. Gypsum is obtained from a deposit 56 miles away.

The limestone, which is hand-loaded at the quarry, is passed through a rotary drier, and the shale and limestone are reduced together in a pebble mill. The clinker, with addition of gypsum, is pulverized in a second pebble mill. Provision is made for plant expansion when the occasion arises.

11. Cementos Portland Moctezuma, S.A., Cuernavaca (Morelos). A new cement plant built at Cuernavaca began production late in 1944. The kiln is 8 by 260 feet, and the plant has a capacity of 200 metric tons (1,170 barrels) daily. It was reported in 1945 that, owing to transportation and operating difficulties, production had not exceeded 80 metric tons a day. Power was first provided by Diesel-driven generating units, but later it was purchased. Plans are made to enlarge the plant when equipment becomes available.

12. Cemento Portland Blanco de Mexico, S.A., "La Polar," Tlalnepantla (Hidalgo). This small plant 8 miles north of Mexico City, which began operation in 1944, makes white cement only. It has one 6- by 60-foot kiln, but addition of a new 7- by 20-foot kiln is contemplated. The present capacity of the plant is not recorded, but it probably does not exceed 50 metric tons (290 barrels) daily.

13. Cementos Veracruz, S.A., Orizaba (Veracruz). This company is a subsidiary of Cementos Atoyac, S.A., of Puebla. A new cement plant to supply the needs of the State of Veracruz, construction of which began in September 1943, began operation in September 1945. Most of the equipment was obtained from the dismantled Hawkeye plant at Des Moines, Iowa, which had been replaced by a new plant some years ago. The two kilns are each 8 by 121 feet, and the plant has a capacity of 200 metric tons (1,170 barrels) a day. Late in 1945 orders were placed for machinery wherewith to increase the capacity to 300 metric tons a day.

The limestone quarry is 4 miles in one direction and the shale pit 1 mile in the opposite direction from the mill. A natural spring supplies abundant water, and waste-heat boilers will make the plant independent of hydroelectric power shortages that occur during the dry season.

The limestone and shale, loaded with electric power shovels, will be hauled in 20-cubic yard, steel, side-dump cars by a 55-ton Diesel-electric locomotive. The rock, reduced by hammer mill, will pass through a rotary drier and will be pulverized in a compartment mill. Clinker with addition of gypsum is ground in a second compartment mill. Both ground raw materials and finished cement will be conveyed by the Fuller-Kinyon system. Bag-type dust collectors will serve both the packhouse and the grinding mills.

14. Cementos Portland del Bajio, S.A., Leon (Guanjuato). Construction of this new plant was begun in January 1945, and operation was expected by January 1, 1946. It is being built almost entirely with used equipment in good condition from various United States plants. Calcining equipment consists of two 8-1/2- and 10- by 150-foot, and one 9- by 142-foot kilns. They will

have induced draft through steel stacks and will be furnished with modern automatic control equipment. The estimated capacity is 450 metric tons (2,640 barrels) a day.

Limestone will be obtained from a quarry 9 miles distant, and the clay pit is on the plant site. A noteworthy characteristic of this mill is its design for reducing both raw materials and finished cement in a greater number of stages than is customary. The limestone will first be broken in a gyratory crusher with a 30-inch opening and further reduced in a gyratory crusher with 10-inch opening. After drying and addition of dried clay it will be broken to finer sizes in a hammer mill in closed circuit with screens. Final reduction will be accomplished in 10 5- by 22-foot tube mills, 5 for preliminary and 5 for finished grinding.

Clinker will first be reduced in a cone crusher in closed circuit with screens, and final reduction will be accomplished with tube mills in two stages using a lay-out identical with that employed for pulverizing the raw materials. Pulverized raw materials and finished cement will be conveyed to storage bins by the Fuller-Kinyon pump system. Provision has been made for enlarging the plant when justified by conditions.

15. Cementos del Norte S.A. Monterrey (Nuevo Leon). This is a slag-cement plant located near the mill of Cementos Mexicanos, from which it will obtain clinker and mix it with slag obtained from a smelter. The mixture in the proportion 75 percent slag to 25 percent clinker with gypsum added will be ground in a conical mill in closed circuit with a vibrating screen. Final grinding will be done with tube mills. Tests conducted over the past 2 years indicate that when ground to a fineness of 1,600 cm. surface area per gram it gives a low 7-day strength, but its 28-day strength is comparable with that of standard Mexican portland cement. The plant is designed to make a cement suitable for foundations, dams, and other purposes where high early strength is not necessary. It has the advantage of furnishing 400 barrels of cement for each 100 barrels of clinker and at the same time utilizes slag the disposal of which had become a difficult problem. It will be sold under the trade name "Atlante". No data are available on plant capacity.

16. Cementos del Pacifica, S.A., Mazatlan (Sinalva). The foundations of this plant had been poured by mid-1945 and some equipment installed. Its estimated capacity, according to one report, is 120 metric tons (700 barrels) and according to another 150 metric tons (900 barrels) a day. It has an 8- by 150-foot kiln and will generate its own power with Diesel engines. It is being built in a jungle about 30 miles from Mazatlan under rather difficult conditions. The limestone quarry is 3-1/2 miles from the plant, but will have railway connection.

17. Cementos Anahuac Tlalnepantla (Hidalgo). This plant, which will produce portland puzzolan cement, was under construction in 1945. It will have one 8- by 125-foot kiln with a capacity estimated at 100 metric tons (590 barrels) daily. According to report, it will also manufacture lime in three shaft kilns for use in making its puzzolanic brands of cement.

18. Cementos de Chihuahua, Chihuahua (Chihuahua). The company has been reorganized and having adequate capital had made definite plans early in 1945 to erect a new cement plant on the site of a small, poorly designed plant which was operated for a short time but ceased activity in 1943. Its planned capacity is 150 metric tons (880 barrels) a day.

Further expansion of the cement industry of Mexico is contemplated. The most promising of the projects is erection of a small plant in Yucatan on the Gulf coast. Limestone is available near Merida, but recently it appears that more suitable material occurs near Campeche. The cost of the projected plant is estimated at $330,000, $124,000 of which is to be furnished by industrialists, an equal amount by the Banco Nacional de Mexico, and the balance by the Government.

The following table shows the principal statistics of cement in Mexico during recent years. No exports of cement from Mexico are recorded.

Imports, production, and consumption of cement in Mexico 1935-43, in metric tons

Year	Imports from the U.S.	Total imports	Production	Consumption[1]	Per capita consumption, bbl.(376 lb.)
1935	[2] 12,735	-	251,651	-	-
1936	[2] 5,464	6,898	285,978	292,876	0.09
1937	[2] 3,671	11,757	344,693	356,450	.11
1938	[2] 3,972	13,883	373,729	387,612	.12
1939	[3] 1,154	[3] 5,064	409,784	414,848	.12
1940	[3] 3,673	[3] 4,476	484,992	489,468	.15
1941	[3] 4,046	[3] 4,055	537,464	541,519	.16
1942	[2] 13,832	[2] 13,832	588,476	602,308	.18
1943	[2] 59,314	[2] 59,314	578,253	637,567	.19

[1] Production plus imports.
[2] Exports from the United States to Mexico.
[3] Data from Estadistica del Comercio Exterior.

SOUTH AMERICA

Argentina

In early years Argentina depended greatly upon imports of cement. In 1920 the country produced about 39 percent of its requirements, in 1925 only 30 percent, and in 1928, 35 percent. In 1931 there were only four cement plants in the country, and they produced less than half of the national requirements. Belgium was the chief foreign source. Imports from Belgium amounted to 160,000 metric tons in 1930, which was 42 percent of total imports. The market for cement has expanded greatly because of extensive highway, grain elevator, and public works construction and because of the growing use of cement in home building.

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A serious shortage of cement developed during 1937 because of the accelerated rate of public and private construction. In order that a larger volume of foreign supplies might become available, an active demand arose for a downward revision of import duties. The situation became so serious that the Argentine Sanitary Works Department appointed a special committee to study the industry's problems. To ease the situation, the high rate of activity in the public works program was checked. The shortage of cement supply encouraged active measures to attain self-sufficiency in cement manufacture. The completion of three new plants was expedited, and the facilities of existing plants were enlarged. Production, which in 1927 was only about 200,000 metric tons, increased to over 1,000,000 tons in 1937, and plant capacity was more than 2,000,000 tons in 1945.

In 1943 a decree was enacted fixing the minimum output of cement from Argentine factories at 1,000,000 tons a year and making provision for adequate fuel supplies to manufacture this quantity. A decree enacted in June 1943 prohibited the exportation of cement from the country. The purpose was to lower construction costs, conserve fuel, and assure adequate supplies of cement for local markets. The strong movement toward self-sufficiency is indicated by the trend of imports, which dropped from more than 477,000 tons in 1928 to 926 tons in 1940 and to zero in 1941.

There are 11 active cement plants in Argentina, most of them in the central belt. They are located in Provinces as follows: Buenos Aires 4, Cordoba and Mendoza 2 each, Entre Rios, Santiago del Estero and Salta 1 each. Unlike Mexico, which has only 1 wet-process plant, 5 of the Argentine plants employ the wet method. The investment in the Argentine cement industry is estimated at the equivalent of $40,000,000 in U. S. currency. The plants are described by Provinces in the following paragraphs.

1. Compañia Argentina de Cemento Portland, Sierras Bayas (Buenos Aires). United States capital and management were responsible for erection of the first large cement plant in Argentina. The Lone Star Cement Co. (International Cement Corp.) built a dry-process plant at Sierra Bayas, which began production in 1919. The company, known as Compañia Argentina de Cemento Portland, was capitalized at $3,000,000.[7] The plant is situated in a rich agricultural country about 200 kilometers south of Buenos Aires. The limestone area occupying 320 acres has an adequate supply for approximately 70 years at the present rate of operation. Two quarries furnish the raw material. The limestone is reduced with gyratory crushers and hammer mills, and final grinding is done in tube mills. The two original kilns were each 10 by 150 feet. Three kilns were added later, but their dimensions are not recorded. The clinker is pulverized in tube mills. Oil from the Comodoro Rivadaira oil field is used for fuel. Power is supplied from waste-heat boilers. The plant has an annual capacity of 400,000 metric tons of finished cement. Warehouses are maintained at Avellaneda, where bulk cement is repacked. The company has taken a particular interest in looking after the welfare of its employees, providing them with a townsite equipped with stores, church, and school.

7/ White, John W., Argentina's Cement Industry: Am. Weekly (Buenos Aires), vol. 2, No. 9, Aug. 30, 1924, pp. 5-7, 28-30.

2. Loma Negra S.A. Lomas Negras (Buenos Aires). A wet-process plant was built by this company near Lomas Negras in 1927. The raw materials, limestone and clay, are obtained by open-pit operations not far from the plant. The rock, brought to the plant by narrow-gage railway, is first reduced by hammer mills. The clay, which disintegrates in a pool, is elevated by ferris wheel to silo storage, from which it is pumped to the mill. The mixed raw materials are pulverized in four-compartment tube mills. Nearly all of the machinery is of German manufacture (Polysius and Krupp). The finished slurry is corrected for composition in silos and pumped to the four kilns. Three of the kilns are approximately 9, 12, and 10 by 223 feet, and the fourth 9 and 10 by 223 feet. They are equipped with slurry filters or driers. The clinker with addition of gypsum, is ground in five-compartment mills, each with three compartments. Power is furnished by Diesel engines and steam turbines. The plant has an annual capacity of 450,000 metric tons of finished cement. The company maintains 400 homes for workers and has made adequate provision for first aid, hospitalization, and social and recreational activities.

3. Corporacion Cementera Argentina, S.A., Papinas (Buenos Aires). A very large deposit of cement rock furnishes raw material for the wet-process Papinas plant. The rock is crushed with a hammer mill and ground in compartment mills having four or five compartments. The kiln is approximately 11 feet in diameter and 354 feet long. Clinker cooling and heat recovery are accomplished with a patent mechanism invented by the president of the company. The Fuller-Kinyon pump system is used for conveying finished cement. The capacity is 160,000 metric tons annually. Power is furnished by a four-unit Diesel-electric power plant. The company has taken active measures to provide for the health and welfare of its employees.

4. Calera Avellaneda, S.A., San Jacinto (Buenos Aires). This small plant, no description of which is now available, has a reported capacity of 60,000 metric tons a year.

5. Compania Argentina de Cemento Portland, Parana (Entre Rios). A new plant was built at Parana in 1938 at a reported cost of $2,430,000. Its location on the Parana River, which affords water transportation for cement, is so advantageous that on several previous occasions steps were taken to establish a cement industry there, but each investigation of the possibilities proved that the lime content of the rock was too low and the silica too high to make a suitable raw material for cement manufacture. However, introduction of a flotation process for purifying cement raw materials at Valley Forge, Pa., proved so successful that the new plant at Parana was designed to employ it and thus make possible utilization of rock too impure for use without such treatment. The deposit of shell limestone, which is very extensive, was purchased in 1935, and after careful research and experimentation a plant of the most modern design was begun. Raw rock for the flotation plant is ground to a fineness of about 88 percent through a 100-mesh screen, which is just fine enough to break the physical bonds between the limestone and silica grains. By flotation the silica content of the rock is reduced from more than 30 to less than 4 percent. Proper adjustment in composition is made in slurry tanks, and the slurry is calcined in a 394-foot kiln. The mill has a capacity of

[illegible] metric tons a year, and the first shipment was made in February 1938. The plant has been described in detail in the technical press.[8]

6. Sud Americana de Cemento Portland, Juan Minetti e Hijos, S.A., Cordoba (Cordoba). The plant constructed in 1930 has two 230-foot kilns manufactured by the Polysius Corp., Dessau, Germany. It is a wet-process plant equipped with the most modern devices, including slurry filters and waste-heat boilers. Oil is used as fuel. The quarry, which is about 1 kilometer from the plant, is in hard, crystalline limestone hand-sorted to separate undesirable magnesian beds. Clay, which constitutes 10 to 15 percent of the raw materials, is obtained about 4-1/2 kilometers from the plant. Both rock and clay are conveyed by aerial tramway. Situated at the edge of a city having a population of about a quarter of a million people, this plant has an excellent market for its product. During the first 5 years of operation it ran at maximum capacity. Robinson[9] has described the plant in some detail. Its capacity is estimated at about 160,000 metric tons per year.

Owing to a sharp reduction in fuel oil and coal importations in 1945, steps were taken to utilize emergency fuels. In both the Cordoba and Mendoza plants operated by this company, good results were obtained by using pulverized charcoal and wheat bran to replace fuel oil in part.

7. Corporacion Cementera Argentina, S.A., Cordoba (Cordoba). The raw materials for this dry-process plant consist of a crystalline high-calcium limestone and a stiff clay. The stone is broken in a hammer mill, and raw grinding is accomplished in a compartment mill having three compartments. A second identical mill is used for clinker grinding. The original mill was equipped with one 7- by 200-foot kiln, but in 1935 a second kiln of the same size was added. Part of the power requirement is purchased from a light and power company in Cordoba, and the remainder is generated with Diesel-electric units. Ground raw rock and cement are conveyed by means of Fuller-Kinyon pump systems. The capacity of the plant is said to be 70,000 metric tons a year.

8. Sud Americana de Cemento Portland, Juan Minetti e Hijos, S.A., Panquena (Mendoza). The original mill situated near the city of Mendoza had a single Lepol kiln. Limestone and shale are obtained 6 kilometers west of the plant. Fuel oil is used for calcination. Increasing demands for cement for road making and street paving encouraged the addition of a new dry-process unit, construction of which was begun in August 1938. The machinery was purchased in the United States at a reported cost of $237,000. The new unit comprises a 260-foot kiln, together with the necessary raw-grinding, clinker-cooling, and clinker-grinding equipment. Its capacity is about 200,000 metric tons of

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[8] Posselt, E., and Trauffer, W. E., Design of New South American Cement Plant Takes Full Advantage of Breerwood Process of Flotation: Pit and Quarry, vol. 31, No. 5, November 1938, pp. 40-56.
Rock Products, Argentine Cement Plant Uses Flotation Process: Vol. 41, No. 11, November 1938, pp. 24-33.

[9] Robinson, A. W., Demand for Cement Keeps Plant Running at Capacity for Five Years: Pit and Quarry, vol. 28, No. 6, December 1935, pp. 31-34, 38.

finished cement per year. It was completed and ready for operation late in 1939. This addition has been described by Wolff.[10] Power for the original plant was obtained from a hydroelectric station 20 miles distant, but the new kiln and equipment are powered with a Diesel-engine plant built by the cement company. Total plant capacity is estimated at 300,000 metric tons per year of finished cement.

9. Corporacion Cementera Argentina, S.A., Cap-devila (Mendoza). The Cap-devila plant built in 1936 consisted of one 7- and 8-1/2- by 226-foot kiln. A second identical kiln was introduced in 1938. It is a dry-process, oil-fired plant. Raw material and clinker are ground in compartment mills. The capacity of the plant is 110,000 metric tons per year. Both standard and puzzolanic cements are made.

10. Compañia Industrial Nortena, S.A., Frias (Santiago del Estero). Construction of a new wet-process cement plant 3 miles from Frias was begun in February 1937, and the first clinker was made in December of that year. A suitable deposit of pre-Cambrian crystalline limestone is about 18-1/2 miles from the plant. The mill was not constructed near the quarry because of a shortage of water. An adequate water supply for the plant is obtained from two wells, each 60 meters deep. The limestone is an argillaceous cement rock which upon appropriate mixing will supply a suitable raw mix without the addition of clay.

An electric-driven 24- by 36-inch jaw crusher reduces the stone at the quarry, and the crushed product is taken to the mill by railroad. Gypsum, obtained from a deposit 7-1/2 miles from the quarry, is hauled in two-wheel mule carts to the quarry, where it is crushed and hauled to the plant in the same way as the stone is conveyed. The raw material ground in a tube mill is adjusted for composition in mixing tanks and calcined in a kiln approximately 10 feet in diameter and 371 feet long. The kiln has four zones: (1) Evaporation, (2) decarbonation, (3) clinkering, and (4) cooling. Zones 2, 3, and 4 are lined with refractory brick. Oil is used for fuel. The clinker is also ground in tube mills. Four Diesel-driven motors furnish the necessary power. As ordinarily there is no rain from May to December special provision has been made for dust collection, particularly in the power plant. The annual capacity is 125,000 metric tons of finished cement. Coproducts are ground hydraulic lime, ground quicklime, crushed-stone aggregates, and ballast. The plant has been described in some detail by Bartholomai.[11]

11. Sud Americana de Cemento Portland, Juan Minetti e Hijos, S.A., Campo Santo (Salta). A dry-process plant built at Campo Santo in 1939 has one 8-1/2- by 260-foot kiln. The principal raw material is porous limestone, which is conveyed 9 kilometers to the plant over an aerial cableway of German manufacture. The mill equipment was purchased in the United States. Both clay and

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[10] Wolff, Joseph M., Argentina Cement Plant Enlarged to Meet Heavy South American Demand: Pit and Quarry, vol. 32, No. 6, December 1939, pp. 30-33.

[11] Bartholomai, Alfredo, Portland-Cement Plant in Argentina Serves a Rich Agricultural Region: Pit and Quarry, vol. 33, No. 1, July 1940, pp. 36-40.

gypsum are obtained locally, and oil is used as fuel. The capacity is said to be 18 metric tons per hour, or roughly 145,000 tons per year. Newcomer[12] has described the plant in detail.

Owing to a sharp reduction in imports of fuel oil in 1945 the company took measures to employ emergency fuels. Three gas producers were built to develop gas from wood. By replacing 65 percent of the fuel oil with gas the quality of the cement was not impaired, although the rate of production was reduced about 25 percent.

In addition to the plants already described, it was reported in 1943 that a new plant was under construction by Cimento Portland Parana at Parana (Entre Rios) and that it was nearing completion. The Campo Santo and Frias plants, supplemented by shipments from Cordoba, supply the northern sections, while the other plants, together with a substantial part of the Cordoba output, satisfy the needs of the central and southern regions.

Capacity figures for the several plants vary considerably according to different authorities, and some of the figures used in this report, although they represent the best available data, appear to be out of line with what one would expect. It must be realized of course that no set rule can be established for the output of kilns of any given size, because so much depends upon quality and kind of fuel, temperature and time of calcination, physical character of raw materials and adequacy of other mill equipment. However, the reported capacities as given in the preceding descriptions present discrepancies in certain instances that are difficult to explain. For instance one dry-process plant having two 7- by 200-foot kilns has a reported capacity of only 70,000 metric tons a year, whereas for another dry-process plant having a single 8-1/2- by 260-foot kiln the capacity is said to be 145,000 metric tons.

The total capacity of all plants in the country, however, as given by different authorities check quite closely. A commercial attaché of the State Department (George R. Canty) estimated the total capacity of the 11 plants in January 1942 at 2,111,240 metric tons. A writer[13] in a technical journal gave an estimate of 2,076,000 metric tons, and the figures given in this report show a total of 2,115,000 metric tons. It may be assumed therefore that a capacity of 2,100,000 metric tons which is equivalent to about 12,000,000 barrels per year is approximately correct.

A Cement Exporters' Conference was organized in 1928 in Buenos Aires by European cement manufacturers. It allotted sales quotas and maintained prices through controlled marketing. The Conference originally comprised certain Belgian, German, and Swedish groups which were subsequently joined, it is said, by English and Argentine groups. The conference has undoubtedly been inactive during the war years, and its postwar status is unknown. Argentina's present self-sufficiency renders such an organization virtually obsolete.

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[12] Newcomer, V. K., A New Dry-Process Cement Plant in Argentina: Pit and Quarry, vol. 32, No. 1, July 1939, pp. 36-43.

[13] Rockwood, Nathan C., Latin America's Cement Industry Expands: Rock Products, vol. 44, No. 11, November 1941, p. 43.

American brands of cement are regarded highly, but imports have always been small because of inability to compete in prices.

Normally all the cement plants of Argentina use fuel oil, as very little suitable coal is available. As World War II developed, fuel-oil supplies became more and more restricted. In 1941 the reduction in supply was about 30 percent of prewar requirements, in 1942 and 1943 it was 40 percent and in 1944 50 percent. The cement industry therefore was forced to seek other kinds of fuel. Substitute fuels used included bran, sawdust, coal, charcoal, and even producer gas derived from wood. Although many difficulties were encountered, the supplementary fuels assisted the industry in maintaining production at satisfactory levels.

The following table shows the principal statistics of the cement industry of Argentina during recent years.

Imports,[1] exports, production, and consumption of cement in Argentina, 1935-43, in metric tons

Year	Imports from U. S.	Total imports	Exports	Production	Consumption[2]	Per capita consumption, bbl. (376 lb.)
1935	3,993	35,065	-	721,564	756,629	0.35
1936	4,497	27,646	-	833,631	861,277	.40
1937	4,920	109,862	-	1,035,495	1,145,357	.53
1938	6,132	74,931	-	1,245,458	1,320,389	.61
1939	3,967	32,957	1,519	1,127,608	1,159,046	.53
1940	2,686	9,330	6,725	1,182,279	1,184,884	.54
1941	3,858	14,178	31,974	1,168,281	1,150,485	.53
1942	359	1,773	95,221	1,076,858	983,410	.45
1943	1,888	3,328	13,720	957,076	946,684	.43

[1] Data on imports from the United States, 1935-38, are United States figures of exports to Argentina.
Data on all imports, 1939-43, from Anuario del Comercio Exterior.

[2] Production plus imports minus exports.

Bolivia

Bolivia is an isolated, mountainous country. About 80 percent of the population are Indians who have a very low purchasing power, which has been reduced further as a result of the Chaco War. The country has very few concrete roads, and most of its buildings are made of adobe brick covered with plaster, hence the demand for cement is not great and is confined principally to the larger cities and to the region adjacent to the coast. The building trades are in the hands of Indian or half breeds (Cholos), who are not progressive in the use of improved building materials. As the country is slowly becoming industrialized, the outlook for future markets is more favorable.

A $95,000,000 contract was awarded in July 1945 for a 295-mile highway between Cochabamba and Santa Cruz. Although designed as an asphalt road, it will doubtless require large quantities of cement. Water-supply facilities, an airport, street paving, and other heavy construction projects are planned for the city of La Paz.

In the early and middle twenties the Foundation Co. of New York constructed streets, sewerage systems, and waterworks in Bolivia and Peru and had, as one of its large projects, a sanitary works for the city of Oruro, Bolivia. As imported cement was costly and conditions appeared favorable for an expanding cement market, leases were obtained on limestone deposits. At first it was planned to build a cement plant at Rosario near the Chilean border, but preference was given later to a higher-grade limestone near Copacabana on Lake Titicaca. The mill, however, was situated at Viacha about 30 kilometers from La Paz at the junction of three railroads. The operating company is the Sociedad Boliviana de Cemento of La Paz. It is probably the world's highest cement plant, as the altitude is 12,960 feet above sea level. According to Willimek[14] the company was organized in 1926, and production was begun in 1928. Initial capital was 120,000 bolivianos (about $45,000). The capital was subsequently increased to 1 million bolivianos, of which about 300,000 was local capital and the remainder was supplied by Peru and the United States. It is reported, however, that the Bolivian branch of the British firm Duncan, Fox & Co., La Paz, has invested in the Bolivian cement industry and is one of the agencies for marketing the product. Plant equipment was imported from the United States. Fuel oil is brought in over the Guaqui-La Paz Railway. An abundance of good clay is available near the mill. It is a dry-process plant, the original kiln of which is 8 feet in diameter and 100 feet long. In 1939 an air-quenching clinker cooler was installed. Both raw materials and clinker are ground in pebble mills. Originally the capacity of the plant was 50,000 barrels a year, and subsequently it was increased to 150,000 barrels (26,000 metric tons).[15] The company was permitted to import oil and sacks duty-free for 5 years but was required to give a 10-percent discount on Government orders.

With completion of the sanitary works at Oruro, marketing difficulties were encountered which were augmented by the depression, a decline in the price of tin (the principal source of income for Bolivia), and a continuation of the disastrous Chaco War with Paraguay. The Government and the railroads, the largest consumers of cement, can import their requirements duty-free and with freight rebates. For other consumers the import duty is almost prohibitive - 1 boliviano per 100 kilos (about 62 cents a barrel) plus additional charges amounted to 130 percent. Imports which before the Second World War originated in many countries, chiefly Germany, were principally for special uses. Low-price European cements, including considerable natural cement, were in greater demand than the better grades from the United States. Imports in prewar days entered Bolivia by way of the ports of Mallendo, Peru, and Antofagasta and Arica, Chile. Prices of both domestic and imported cements were high.

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[14] Willimek, Rudolf, Der Stand der Zementindustrie in den Kordilleren Staaten: Zement, vol. 27, No. 9, March 3, 1938, pp. 131-134.

[15] For a detailed description of the plant see Cement and Cement Manufacture, London, vol. 2, No. 4, April 1929, pp. 108-109.

A difficulty in filling orders in 1944 was evidently due mainly to a shortage of limestone supplies. The limestone property situated 20 kilometers from the plant is owned by an Indian community. It was agreed that the annual rental would be increased 33-1/3 percent and that the output of the quarries would be increased enough to double the yield of the cement plant, which was at that time about 25,000 metric tons per year. Such increase was made possible by the addition of a new 7- by 100-foot kiln and supplementary equipment, which was scheduled for completion in 1943.

The need for expansion of output was evidenced by serious shortages of cement that had developed in some localities. Arrangements were made with Argentina in 1944 to supply 100 tons of cement a month to the Department of Tarija, where sanitary projects were at a standstill lacking cement. Additional production from Bolivia's own plant would help to supply such deficiencies and also permit completion of the paved road between La Paz and Altiplano, construction of which was delayed through lack of cement.

Consideration has been given to the possibility of establishing a new plant; but according to report, no steps will be taken toward this end until it appears that the existing plant is unable to supply the needs.

The following table presents the principal statistics during recent years.

Imports, production, and consumption of cement in Bolivia, 1935-43, in metric tons

Year	Imports from the U.S.1/	Total imports	Production	Consumption2/	Per capita consumption, bbl. (376 lb.)
1935	115	1,177	40,212	41,389	0.07
1936	77	2,152	61,841	63,993	.12
1937	200	13,174	(3/)	(3/)	-
1938	30	(3/)	(3/)	(3/)	-
1939	25	2,459	(3/)	(3/)	-
1940	108	589	143,921	144,510	.25
1941	(3/)	3,505	(3/)	(3/)	-
1942	2,247	6,865	133,809	140,674	.24
1943	1,049	3,951	134,382	138,333	.24

1/ Data on imports from the United States, 1935-38, are United States figures of exports to Bolivia. Data on all imports, 1939-43, from Comercio Exterior.

2/ Production plus imports.

3/ Data not available.

Brazil

Although several unsuccessful ventures are recorded in the early history of the cement industry in Brazil, in recent years greater success has been attained, and such rapid strides have been made that the country, except for certain outlying territories, is virtually self-sufficient.

Among the unsuccessful enterprises was a plant built in 1912 at Rodovalho, State of Sao Paulo, by the S. A. Fabrica Votorantim. It operated only a short time, and its failure is ascribed to poor management, an inferior product, and high fuel cost.

In 1917 an Italian company, Macchiorlatti & Cia, took steps toward building a cement plant at Bello Horizonte, Minas Geraes, but the venture apparently failed. Similarly a French company, Compagnie Franco-Bresilienne, was organized in Paris for the purpose of manufacturing cement in Brazil, but it also failed to materialize.

About 1924 German capital backed construction of a plant near Victoria, State of Espirito Santo. The plant failed because it was too small for economical operation.

The first plant that maintained consistent operation was built in 1912, two more were built in the 1920s, and four more since 1930. Thus from a state of pronounced dependence upon foreign sources Brazil is now able to handle at least 95 percent of its normal cement requirements.

Cement is a vital product in Brazil. As the domestic steel output is small, cement has been adapted to a great variety of structural products. Cement is one of the few basic industries in which the country has attained a high degree of self-sufficiency. Limestones suitable for cement manufacture are available in many localities. Gypsum for retarder is supplied from deposits in northern areas.

A cement shortage occurred early in 1942 because lack of fuel oil resulted in shutting down several cement plants. Later in the year, enough oil was available for plants to operate at 50 percent of capacity, and this output (supplemented by import of 500,000 bags from Argentina) relieved the shortage. To encourage importation the import duty was suspended for 90 days from August 18, 1942. Later the suspension was extended for another 90 days, expiring February 20, 1943. Similar legislation was passed still later, suspending import duties for 90 days from January 15, 1944. It is important to note that the deficiency of cement and the measures taken to encourage imports were due to fuel shortage, and not to inadequacy of plant facilities.

Following is a brief discussion of the cement plants of Brazil.

1. Sociedade Industrial de Cimento Monte Libano, Cachoeira de Itapemirim (Espirito Santo). The plant now operated by this company was built in 1912 by the State Government and was called "Fabrica de Cimento do Estado do Espirito Santo." It was an unsuccessful State enterprise, as the State never operated it. After 11 years of idleness the Governor was authorized in 1923 to lease it, but a lessee could not be found until 1935, when it was leased for 40 years to Barbara & Cia, Ltda. Later it was acquired by the present operators. The plant has a capacity of about 25,000 metric tons a year. The product is sold under the brand name "Barbara".

2. Companhaia Brasileria de Cimento Portland, S. A., Perus (São Paulo). As early as 1910, the limestones of the State of São Paulo had been investigated and favorable reports obtained. In 1923 they were investigated further by British and Canadian interests, and in 1924 the Companhia Brasileria de Cimento Portland, S. A., was organized. The company was capitalized at 25,000,000 milreis ($1,250,000), of which 24 percent was held by Brazilians and 76 percent by the Canadian Foreign Investment Corp. In 1929 a bond issue of $2,900,000 was authorized to redeem the mortgage of the Canadian syndicate and for additional plant construction. A new rotary kiln completed in 1930 is said to have increased the capacity of the plant from 100,000 to 170,000 metric tons annually.

Construction of the plant was begun in 1925 and completed in 1926. The principal raw material is pre-Cambrian limestone from Agua Fria. Considerable difficulty is experienced because of excessive magnesia in certain parts of the deposit. Clay is obtained at points 4 to 20 kilometers from the plant and gypsum for retarder from the State of Rio Grande do Norte. It is a dry-process plant with a capacity of about 200,000 tons a year. Fuel oil is obtained in the United States and Mexico. The product is sold under the brand name "Cimento Perús."

3. Companhia Nacional de Cimento Portland Guaxindiba (Rio de Janeiro). After diligent search, the Lone Star Cement Corp. of New York, N. Y., the principal stockholder of the above company, located a satisfactory limestone deposit at Sao Jose in the municipality of Guaxindiba, State of Rio de Janeiro. Construction of a plant was begun in November 1931 and production in 1933. Owing to overcapacity of the plant owned by this company in Cuba, part of the equipment of the Cuban plant was dismantled and shipped to Brazil for use in the new plant at Guaxindiba.

The high-calcium limestone quarry situated 16 kilometers from the plant is equipped with a power shovel capable of handling 150 tons of stone an hour. The limestone is hauled to the plant over a company-owned railway. The argillaceous raw material consists of finely divided river mud brought in barges from the mouth of the Macacu River.

Calcination is accomplished in a wet-process plant. The original oil-fired kiln is 400 feet long and 11-1/2 feet in diameter. It was from the start a carefully planned and highly efficient plant, which has been described in some detail in the technical press.[16]

The plant was enlarged in 1935 by addition of a second rotary kiln, which doubled its previous capacity. Cottrell electrical dust precipitators were also installed. The plant is said to have a capacity of about 850 metric tons per day (about 5,000 barrels) or 300,000 tons per year. The brands sold are "Maua" (standard portland cement) and "Incor" (high-early-strength cement). The investment in the plant at that time probably approximated $5,000,000. It was reported in 1941 that a third kiln 8 and 9 by 240 feet was being installed.

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[16] Rock Products, Refinement in Design Feature of New Brazilian Cement Plant: vol. 36, No. 10, Oct. 25, 1933, pp. 20-24.

This would increase the plant capacity to more than 385,000 metric tons a year.

4. S. A. Fabrica Votorantim, near Sarocaba (Sao Paulo). The company office is in Sao Paulo. It is a Brazilian company with Brazilian capital amounting to about $1,000,000.

The limestone deposit which furnished the major part of the raw material is evidently quite extensive. It consists of high-calcium rock averaging about 92 percent $CaCO_3$, associated with some ledges of dolomite which are separated in quarrying. The quarry face is 300 feet high, and the operations are completely mechanized. The calcining equipment consists of 2 kilns each 9 by 330 feet. They are designed for burning oil; but in 1945, when oil was scarce, pulverized charcoal was used. This efficient plant, which is equipped with Danish machinery, has a capacity of about 160,000 metric tons of finished cement a year. The product is sold under the brand name "Voteran".

5. Companhia Parahyba de Cimento Portland Joao Pessoa (Parahyba). The company built a small plant employing German machinery in 1935. Authorized capital is 12,000 contos (about $600,000). The plant is operated by a holding company, Industrias Brazileiras Portella. The product has the brand name "Dolaport." The estimated capacity is 100,000 metric tons per year.

6. Companhia Cimento Portland Itau, Itau (Minas Geraes). The company was organized in 1937. The plant, employing Danish machinery, was completed and began operation in December 1938. It has a capacity of about 45,000 metric tons a year. The cement is sold under the brand name "Itau." The authorized capital is 7,000 contos (about $350,000).

7. S. A. Fabrica Votarantim Paulista (Racife) (Pernambuco). It was said in 1941 that a plant had recently been built by this company. Paulista is over the border in the State of Piauhy.

8. Electro Guimica Brazileria, S. A., Soramenha (Minas Geraes). This plant, no description of which is now available, is said to have a capacity of 40,000 metric tons a year.

According to press reports in 1943, a new company, Companhia Portland Paraná, capitalized at 30 million cruzeiros, was being organized to build a cement plant at Curityba (Paraná) with a daily capacity of 100 tons. No additional information on the project has appeared.

Although the total capacity of Brazilian cement plants had reached nearly 1,000,000 metric tons per year, the output in 1945 was considerably below the market demands.

The following table shows statistics of cement in Brazil for many years. According to press reports production in 1944 was 820,000 metric tons.

Imports, exports, production and consumption of cement in Brazil 1919-43, in metric tons

Year	Imports from the U. S.	Total imports	Exports	Production	Consumption	Per capita consumption, bbl.(376 lb.)
1919	106,389	198,418	-	-	-	-
1920	76,129	172,992	-	-	-	-
1921	8,005	156,872	-	-	-	-
1922	26,342	319,550	-	-	-	-
1923	4,116	223,404	-	-	-	-
1924	1,848	317,152	-	-	-	-
1925	2,467	336,474	-	-	-	-
1926	2,154	396,322	-	13,382	409,704	-
1927	2,471	441,959	-	54,623	496,582	-
1928	3,999	456,212	-	87,964	544,176	-
1929	3,897	535,276	-	96,208	631,484	-
1930	2,591	384,503	-	87,160	471,663	-
1931	1,196	114,332	-	167,115	281,447	-
1932	991	160,534	-	149,455	309,989	-
1933	1,582	113,870	-	225,680	339,550	-
1934	2,264	125,702	-	323,911	449,613	0.06
1935	751	114,154	-	362,999	477,153	.07
1936	74	78,198	-	483,023	561,221	.08
1937	137	74,831	-	571,452	646,283	.09
1938	62	41,000	-	2/650,000	2/691,000	.09
1939	(3/)	2/41,098	15	697,793	738,876	.10
1940	3,160	22,786	402	793,634	816,018	.11
1941	10,611	18,308	603	767,506	785,211	.11
1942	4/ 5,982	74,814	(3/)	752,839	827,653	.11
1943	4/14,551	16,080	(3/)	747,409	763,489	.10

2/ Estimated.
3/ Data not available.
4/ Exports from the United States to Brazil.

Chile

Greatly increased demands for cement in Chile are in prospect. Late in 1945 bids were opened for 300 miles of highway between Santiago and La Sarena including five large reinforced-concrete bridges. Sixty-five miles of the highway will be paved with concrete. To complete the $15,000,000 project will require at least 4 years. Two major vehicular tunnels are also planned on the road between Santiago and Valparaiso.

1. The principal producer of cement in Chile is Sociedad Fabrica de Cemento de El Melon, founded in 1906. According to Willimek,17/ the plant, which is near Calera, a town between Valparaiso and Santiago, had an initial

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17/ Willimek, Rudolf, Die Entwicklung der chilenischen Zementindustrie: Zement, vol. 27, No. 3, Jan. 20, 1938, p. 43-44.

capacity of 115,000 tons per year. Owing to lack of capital and foreign competition, the company operated on a small scale until World War I. After the war more favorable exchange rates and increased import duties permitted an expansion in capital and markets. In 1916 the capacity was increased to 175,000 tons a year. The original plant, the machinery for which was furnished by F. L. Smidth Co., of Copenhagen, was closed in 1930 and was replaced by a new dry-process unit of much larger capacity, the machinery for which was obtained in the United States. Owing to increasing markets, a new kiln and enlarged clinker bins were added in 1935. The capacity of the plant was then 250,000 tons a year, and it was increased again in 1937 to 375,000 tons. The calcining equipment as reported in 1941 consisted of three 10- by 170-foot kilns and two 10- by 240-foot kilns. Both raw materials and clinker are ground in pebble mills. Quick-setting and waterproof cements are made in addition to standard portland cement. Chilean coal, obtained at Lirquen, 500 miles from the plant, is used for fuel. The reserve of high-grade raw materials is said to be adequate for 50 years' operation at the present rate of production. The limestone deposit that furnishes the principal raw material is one of the few commercial occurrences in Chile. A "low-lime" deposit is located 1 mile from the plant, and a "high-lime" deposit is 10 miles away. The limestone beds dip at an angle of 30°, and underground mining is conducted under difficult conditions. The "low-lime" (Calera deposit) rock is crushed to 3/8- inch and the "high-lime" (Navio deposit) rock to 4-inch size before shipment to the mill. Both raw rock and clinker are ground in ball mills. The company has its own hydroelectric power plant. Two additional kilns which were being added in 1945 will increase the plant capacity to approximately 500,000 metric tons per year.

The investment was said to be 32,700,000 pesos ($3,949,670) in 1930 and 53,800,000 pesos ($2,756,712) in 1936. (In 1930, 1 peso was worth 12.079 U.S. cents; in 1936, only 5.124 U. S. cents.) It is reported that the Chilean Government owns about one-third of the capital stock. Most of the remainder is held by resident English or Anglo-Chileans. The company is well-established financially, and the plant has been notably profitable. According to report, profits from 1916 to 1923 averaged 21.3 percent, and in 1936 they were 17.6 percent.

2. A serious shortage of cement which hampered public works and other building construction developed in 1941. As a result of the 1939 earthquake the demands for cement had multiplied. The El Melon plant was inadequate to supply the needs, and steps were taken to import cement from Argentina. Prices, which had advanced sharply, were placed under Government control. These circumstances impressed upon the nation the need for increased cement-production facilities, and active measures were taken in 1941 to erect a new plant to supplement the output of the single existing plant in Chile.

In August 1943 construction was begun by Sociedad de Cemento Juan Soldado S. A. on a new wet-process cement plant near Coquimbo about 9 kilometers from the city of La Serena. Active steps were first taken to this end in 1941, when the Corporacion de Fomento de la Produccion (Chilean Development Corporation), a joint government-business agency, was empowered to purchase used equipment in the United States. The equipment of two inactive cement mills in New Jersey was purchased. It included eight 8- by 125-foot rotary kilns which were rebuilt into four 9-1/2- and 8- by 199-foot kilns to be used in the new plant.

The raw material consists of bedded shell formations of marine origin, occurring in terraces a few miles north of the plant site. The reserve is said to be adequate for 70 years' operation, but the material is too low in lime and too high in silica for cement manufacture without preliminary treatment. To obtain a properly proportioned mixture, flotation equipment obtained from the New Village, N. J., abandoned plant of Thomas A. Edison, Inc., was installed.

The quarry rock is reduced in a hammer mill, and excess silica in the form of fine sand is removed by screening. The coarser material is pulverized in ball mills and adjusted for composition with hydroseparators and flotation machines. It is reduced further in a tube mill, and the slurry is fed to the four kilns. The kilns are adapted to burn either oil or coal. The clinker is ground in two stages, first with a gyratory crusher and later in tube mills equipped with air separators. Power is generated with waste-heat boilers supplemented by two direct-fired boilers designed to use either pulverized coal or fuel oil. The capacity of the plant is estimated at 250,000 metric tons annually. It began operation on September 15, 1945, and it was expected that production would reach 20,000 tons a month by the end of October. The plant is regarded as one of the most modern, efficient establishments of its kind in Latin America. In mechanization, it is far superior to its sister plant, the El Melon, although the latter has a greater capacity. Further details regarding it have been furnished by Agosin.[18]

3. In January 1945 a large limestone property was acquired about 20 miles northwest of Santiago, and preliminary steps were taken by Fabrica de Cemento Portland Polpiaco to construct a new cement plant having a capacity of 200,000 metric tons a year. Reserves of limestone having an average content of about 74 percent $CaCO_3$ are said to be very extensive. The project includes two 9- by 10- by 35-foot kilns with heat-recovery equipment. Fuel will consist of Chilean bituminous coal of 12,600 B.t.u., obtained in Concepcion and Arauco Provinces. It is estimated that the plant will cost about $3,500,000.

4. Plans are under consideration for building another cement plant at San Fernando in the mid-southern zone, having an annual capacity of 150,000 metric tons. Consideration is being given to the feasibility of conveying Tinguiririca limestone in the form of a slurry of 1:10 dilution 45 miles by means of a launder.

The shortage of cement became acute in 1944, particularly toward the end of the year, when it was aggrevated by a strike at the El Melon plant. Work was resumed when wages were increased. Importation of 900,000 sacks of cement duty free was authorized by the Government in September 1944. Prices of cement were increased twice during 1944, and at the end of the year were double those prevailing in 1941. To relieve this situation it was imperative that the new mill should attain maximum production at an early date. It was estimated in 1945 that the country should have a cement production capacity of at least 1,000,000 metric tons annually by 1950.

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[18] Agosin, M., Old Edison Cement Plant Now Comes to Aid of Chile: Pit and Quarry, vol. 36, No. 6, December 1943, pp. 52-57, 62.

As Argentina cement plants were experiencing an acute fuel shortage early in 1945, and at the same time Chile was greatly in need of cement negotiations were in progress providing for shipments of cement to Chile in exchange for 50,000 tons of Chilean coal.

The following table presents statistics of Chilean cement for a number of years.

Production, imports, exports, and consumption of cement in Chile, 1929-43, in metric tons[1/]

Year	Imports from the U. S.	Total imports	Exports	Production	Consumption[2/]	Per capita, consumption, bbl. (376 lb.)
1929	2,771	241,964	692	145,234	386,506	0.50
1930	1,354	252,073	254	161,743	413.562	.53
1931	52	30,526	87	102,310	132,749	.17
1932	41	11,068	1,792	112,441	121,717	.16
1933	202	974	3,033	139,058	136,999	.18
1934	350	854	8,875	203,416	200,395	.26
1935	821	17,018	880	284,885	301,023	.39
1936	624	1,710	1,193	248,424	248,941	.32
1937	807	1,828	1,316	313,110	313,622	.40
1938	879	1,676	101	363,987	365,562	.47
1939	676	1,463	67	340,786	342,182	.41
1940	972	13,742	50	385,091	398,783	.51
1941	20,647	30,931	138	359,720	390,513	.49
1942	1,316	15,632	2,016	364,584	378,200	.48
1943	1,187	9,308	2,218	374,747	381,837	.48

1/ Data for exports: 1931, Comercio Exterior 1939; 1940-43, Chilena Estadistica.

2/ Production plus imports minus exports.

Colombia

Colombia is well-supplied with raw materials and fuels for cement manufacture. The country is richly endowed with limestone, clay, and gypsum and has natural resources of both coal and petroleum. Its potentialities as a cement producer have been studied by British, Belgian, and United States interests. Cement is attaining increasing importance in Colombia because of expansion in irrigation and transportation projects. Following are brief descriptions of the cement plants of the country.

1. Manufacturas de Cemento, S. A. (formerly Fabrica de Cemento Samper), Bogotá (Cundinamarca). This company with a paid-up capital of 2,830,000 pesos

($1,583,470) built a plant near Bogotá many years ago. Upper Cretaceous limestone, the principal raw material, is obtained at La Siberia, 43 kilometers from Bogotá. A cableway 9.5 kilometers long brings in coal and carries out cement. Machinery was supplied by the Polysius Co. of Germany.[19] The plant has a capacity of 150 tons per day, but the output could be readily increased.

2. Compañia de Cemento Portland Diamante, Apulo (Cundinamarca), with a capital of 2,840,000 pesos ($1,589,065), operates a wet-process plant near Girardot in the southwestern corner of the Province of Cundinamarca. Construction of the plant, for which equipment was supplied by F. L. Smidth & Co. of Copenhagen, was begun in 1927, and production was started toward the end of 1930. The plant is in a valley surrounded by lofty mountains. Limestone, quarried at a high level on the mountainside, is conveyed by gasoline locomotive to storage pits flanked by high concrete walls. The rock flows by gravity to the cone crusher. The raw stone and cement clinker are pulverized in identical pairs of ball mills. Calcining is accomplished in two rotary kilns, one of which is 6.2 and 7.4 by 193.5 feet, and the other 7.4 and 8.4 by 246 feet. A Fuller-Kinyon conveying system transports the cement from the grinding mills to storage silos. The necessary power, which is generated by the company, is chiefly hydroelectric, but a supplementary Diesel unit is also used. According to a report made in 1941, the capacity of the plant is 90,000 metric tons a year of finished cement.

3. Compañia de Cemento Portland Diamante, Bucaramanga (Santander). The plant at Bucaramanga, which produces about 18,000 metric tons a year, supplies Santander markets by truck.

4. Compañia de Cemento Argos, Medillin (Antioquia). This company, with a capital of 657,000 pesos ($367,611), was organized by Jorge Carrisquilla. Machinery was supplied by the Krupp Co. of Germany in return, so it is reported, for an interest in the company. The Antioquia Railway and the municipality of Medellin are large shareholders. No data are available on the size of the plant or on the raw materials used.

5. Compañia de Cemento Argos, Medellin (Antioquia), according to report, began construction of a new plant near Medellin about 1940. The technical press records that production had begun or was about to start in August 1941, but no further information is at hand.

6. Cia de Marmoles y Cementos del Nare, Medellin (Antioquia). Construction of the plant was begun in 1939. The contract was in the hands of Edgar Allen & Co., Ltd., Sheffield, England. The mill was completed and production expected by March 1942, but operation was postponed to July 1943 because of inability to obtain paper bags in the United States. Later reports indicate that operation was delayed until a still later date.

According to the United States Department of Commerce,[20] all plants in Antioquia Province, when completed, will have a total daily capacity of nearly 800 metric tons.

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[19] Cemento (Madrid), la industria sud-Americana del Cemento, Fabrica de Cemento Titan, de Colombia; Vol. 7, No. 78, November 1935, pp. 369-371.

[20] Foreign Commerce Weekly, May 26, 1945, p. 31.

7. Cementos Del Valle S. A. Cali (Valle Del Cauca). Construction of a cement plant at Cali was begun late in 1940, and in June 1942 the plant was said to be in operation with a daily output of 200 metric tons. This wet-process plant has one 7.5- and 8.8- by 253-foot kiln. Fuel is a semianthracite of 13,500-B.t.u. grade. Fuel consumption is said to be 240 kilos per 1,000 kilos of clinker.

It was reported in 1943 that, in addition to the plants already listed, the Compañia de Cementos Portland Diamante of Bogotá was building a new plant in the outskirts of Bucaramanga (Santander). It will be necessary to build a power plant, as there is little purchasable electric current available. An initial output of 100 tons a day with later expansion to 300 tons, was planned.

Domestic capital predominates in the Colombian cement industry. The companies operate independently and have no Government connections.

Before World War II, cement imports reached Colombia chiefly through Tumacao and Buenaventura on the west coast and Cartegena, Barranquila, and Santa Marta on the east coast. Foreign cements were sold chiefly in the coastal regions and in the Cauca and Magdalena River Valleys.

Before 1908 Germany was the chief foreign source of supply, but the United States dominated the market from that year until 1923. Subsequent to 1923 Germany again took the lead, and the Scandinavian countries attained increasing importance.

The import duty on cement is 0.01 centavo per kilo or about 97 cents a barrel. Certain public works projects enjoy customs exemptions.

Cement prices are quite variable in different parts of the country. In 1941, for instance, they ranged from 32 to 42 pesos ($18.24 to $23.94) per metric ton for different plants, but all plants sold to the Government at a special price of 25 pesos ($14.25) a ton. The price at the Cali plant was said to be the equivalent of $23.25 a metric ton in United States money in 1944.

A decline in output which marked the year 1942 was occasioned by shortages of construction materials other than cement. Because of an unusual building boom in 1944, production - even though it reached 235,000 metric tons - was inadequate to meet demands. The shortage was particularly acute along the northern coast, the area farthest removed from producing centers.

The following table shows statistics of cement in Colombia during recent years.

Imports, exports, production and consumption of cement in Colombia, 1935-43, in metric tons

Year	Imports from the U. S.	Total imports	Exports	Production	Consumption1/	Per capita consumption, bbl.(376 lb.)
1935	2/1,587	23,885	-	77,000	100,885	0.07
1936	2/1,681	53,066	-	104,465	157,531	.11
1937	2/2,017	39,881	-	123,175	163,056	.11
1938	2/3,497	52,884	-	144,000	196,884	.13
1939	3/4,135	3/39,094	1,162	167,000	204,932	.14
1940	3/7,086	3/17,887	82	187,628	205,443	.14
1941	3/5,287	3/ 5,616	599	210,912	215,929	.14
1942	3/1,201	3/ 1,380	5,244	207,793	193,929	.13
1943	3/4,148	3/ 4,674	6,153	226,304	224,825	.15

1/ Production plus imports minus exports.
2/ Exports from the United States to Colombia.
3/ Includes portland, white and cal hydraulic cements. Data on imports, 1939-43, from Anuario de Comercio Exterior.

Ecuador

Ecuador is taking active measures to complete its section of the Pan American Highway. On September 1945 work was begun on a 120-mile section of the road connecting Guamote and Tambo in the central part of the country. Completion of the project, probably in 1948, will leave only 50 miles of Ecuador's portion of the road unfinished. Several other road-building projects are also under way; and, although they are largely gravel or asphalt construction, bridges and culverts will require cement.

Both limestone and gypsum are available for cement manufacture in Guayas Province. Ecuador has no coal but abundant supplies of oil.

Ecuador has one cement company, La Cemento Nacional, C. A., located at San Eduardo near Guayaquil, Guayas Province. The original dry-process plant was built in 1922 on a property covering 7-1/2 square kilometers. The plant has easy access to the Guayaquil-Quito Railway and to river transportation. Both domestic and German capital amounting to $75,000 was employed, and the machinery was furnished by the Krupp Co. of Germany. The raw materials are limestone and clay obtained near the plant. The original kiln was only 30 by 2 meters (approximately 100 by 6.7 feet) and had a daily capacity of 240 barrels. It was fired with crude petroleum. The product is said to have been of inferior quality, and according to Willimek21/ the plant was taken over in 1923 by a British-Canadian consortium, the Compania Anonima de Industrias y Construcciones, Guayquil.

21/ Willimek, Rudolf, Der Stand der Zementindustrie in den Kordilleren-Staaten: Zement, vol. 27, No. 9, March 3, 1938, pp. 131-134.

In 1934 an American group interested in the commercial development of Ecuador acquired a 20-year lease on the plant. The new company, La Cemento Nacional, C. A., is capitalized at 400,000 sucres ($36,628). Virtually all the equipment of the old plant was scrapped because of deterioration due to improper maintenance, and second-hand equipment was purchased in the United States. The remodeled plant produced about 250 barrels a day of cement said to be of good quality sold under the brand name "Rocafuerte." It was stated in 1941 that the plant had a capacity of about 17,000 metric tons a year. According to a press report, in 1944 the plant had two 6- by 100-foot kilns, one of German manufacture, and the other, relatively new, obtained in the United States. The plant capacity is said to be about 36,000 metric tons annually. It is poorly designed, requiring excessive labor. Erection of a new, modern plant is under consideration.

Before World War II the plant could not supply the entire domestic demand. Requirements exceeding that furnished by the domestic company entered free of import duties and landing charges. Imports were chiefly from England and Germany, only white cement was obtained from the United States. Recent production statistics indicate, however, that the country had virtually attained self-sufficiency in 1944. In that year production increased 75 percent over 1942 and 24 percent over 1943. At the same time, domestic consumption was contracting due partly to transportation difficulties between the plant and Quito and partly to an almost complete cessation of private construction in the coastal zone. Only about 3 percent of domestic consumption came from foreign sources in 1943. In 1945 the Interamerican Development Commission was working on plans for a new cement plant, but they have not yet materialized. It would seem that development of export trade would be the only justification for increasing domestic plant capacity.

Recent statistics of cement in Ecuador are given in the following table.

Imports, production, and consumption of cement in Ecuador, 1939-43, in metric tons

Year	Imports from the U. S.1/	Total imports1/	Production	Consumption2/	Per capita consumption, bbl. (376 lb.)
1939	383	2,014	14,249	16,263	0.03
1940	197	10,941	16,481	27,422	.06
1941	1,859	2,889	17,014	19,903	.04
1942	4,061	5,230	19,802	25,032	.05
1943	340	949	27,860	28,809	.06

1/ Official Trade Statistics (unpublished).
2/ Production plus imports.

The Guianas

No cement manufacturing industries exist in British, French, or Dutch Guiana (Surinam). The extent of the requirements of each of these countries is indicated in the following table of imports during recent years. It is evident from these figures that the United States has had a small part in this trade.

Imports

Imports of cement into British and French Guiana and Surinam, 1939-43, in metric tons

Year	British Guiana		French Guiana		Surinam	
	Imports from the U. S.	Total imports	Imports from the U. S.	Total imports	Imports from the U. S.	Total imports
1939	-	7,115	-	1,050	1,492	2,082
1940	-	6,234	187	658	486	2,495
1941	-	8,036	225	521	-	2,763
1942	-	3,978	1,071	1,148	1	5,488
1943	195	5,693	-	(1)	-	4,628

1/ Data not available.

Paraguay

Steps were taken by a French company to establish a cement plant at Itapucumi in 1912, but the work was interrupted by the World War. In 1926 a local company repaired and completed the plant, which has been in operation at intervals since that time. According to report,[22] the company employed 200 men and made cement of good quality in 1931, but evidently the plant has been inactive during recent years. The capital of the company was 100,000 gold pesos ($92,150).

Imports into Paraguay totaled 6,600 metric tons in 1939, 6,153 in 1940, and 7,964 in 1941. More recent data are not available.

Peru

Peru has one cement plant. According to Willimek,[23] the machinery was obtained in the United States. The operating company, Compania Peruana de Cemento Portland El Sol, organized in 1916, constructed a one-kiln plant with a capacity of only 125 barrels a day. Raw materials obtained near Lurin were brought to the plant at Lima over a 25-kilometer railway.

A second small plant at Lima, which used raw materials from the same locality, was operated a short time during this early period by Peruvian Sr. Nicanor Garcia y Lastres. It is said to have had a capacity of only 1,500 barrels a month.

Operation of the El Sol company was interrupted because of mechanical difficulties, and it produced only 2,500 tons per year. It was reorganized under the name Compañia Peruana de Cemento Portland, and its capacity was enlarged to 45,000 tons a year. In 1923 operations were entrusted to an American construction concern, the Foundation Co. of New York, N. Y., but it is claimed that a majority of the shareholders were Peruvians, and its name was not changed. Even under the new management the plant was unable to make a satisfactory product, and in 1924 replacement of the old equipment with that of new and modern design was begun. The new dry-process plant using Peruvian fuel oil began production in August 1925 and has been notably successful and profitable to its owners since that time. However, the poor reputation of the early product was a handicap that required years to overcome. According to Blaise[24] the plant had two 8- by 125-foot kilns in 1929. It is said to have furnished half the national requirements in 1927 and two-thirds in 1931-32. A cement shortage in 1936 caused suspension of many private construction jobs. To meet the growing demand, the company added another kiln late in 1936 and a fourth kiln in 1938. According to a report in the technical press, the plant had three 8- and 9-1/2-by 200-foot kilns, and one 8- by 125-foot kiln in operation in August 1943, and the capacity of the plant then was about 210,000 metric tons annually. It was stated that additional kilns were being installed that would increase the capacity to more than 360,000 metric tons, but this has not been verified. About 1940 the kilns were transferred from Lima to the quarry site near Atacongo, 25 kilometers distant. Calcining equipment in 1944 consisted of 2 Lepol kilns, one 8, 9-1/2, and 10-1/2 by 135 feet and the other 8 by 110 feet. In addition, there are three standard dry-process kilns, one of which is 8 by 125 feet and the other 7-1/2 by 125 feet. Plant capacity is about 5,200 barrels per day or approximately 260,000 metric tons per year. The clinker is shipped to Lima, where grinding and bagging are conducted in the original mill.

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[22] Pan American Union Bulletin, Paraguay. Manufacture of Cement: vol. 65, No. 8, August 1931, p. 871.

[23] Willimek, Rudolf, Der Stand der Zementindustrie in den Kordilleren-Staaten: Zement, vol. 27, No. 9, March 3, 1938, pp. 131-134.

The rock used is an argillaceous limestone (cement rock) requiring only the addition of small quantities (seldom exceeding 6 percent) of sand. It is fortunate that the rock contains the necessary argillaceous materials, because in the desert country near Lima clay deposits are unknown. The rock is crushed in hammer mills and further reduced in ball mills in closed circuit with air separators. Virtually all the quarry and mill equipment is of United States manufacture. Climatic conditions are favorable. The climate is similar to that of southern California, except for the fact that there is no rain.

Several attempts have been made to establish additional cement plants in Peru. In 1927 a British mercantile firm and a Peruvian group proposed to build a plant on a harbor a little south of Lima at a cost of £300,000. German, Swiss, and Danish firms have investigated and in some instances reported favorably upon cement projects. Some of the reports were made for the Krupp Co. and the Polysius Co. of Germany. None of these projects materialized. Plans have also been under consideration for new cement plants at Arequipa in the south and at Chiclayo in northern Peru. Early in 1945, the Sociedad Explotadora de la Fabricacion de Cemento was organized with Peruvian capital for the purpose of constructing a plant in the Sinbal district in the Province of Frujillo.

The present plant seems to be capable of supplying most of the needs of Peru, and imports have decreased greatly during recent years. The increased capacity of the present plant, in fact, furnished a small exportable surplus in 1942, 1943, and 1944, chiefly to Chile, Bolivia and Ecuador.

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[24] Blaise, P. C., Peruvian Cement Co.'s Cement Mill at Lima, Peru: Rock Products, vol. 32, No. 21, October 12, 1929, pp. 59-65.

Before the war most of the imports, which originated principally in Germany and Japan, were shipped to outlying sections in the north and south, and these areas still provide markets for foreign cement. Stucco is very popular in Peru, and this chiefly explains the imports of white cement, considerable quantities of which originate in the United States. Importation is handicapped to some extent by the high cost of the delivered cement. To the price of the imported product must be added an import duty, customs, surtaxes, an unemployment tax, and landing charges amounting in all to about $1.25 a barrel, which make it difficult for foreign cement to compete with domestic in the Lima-Callao and Central Peru districts. Conversely, high transportation costs discourage competition of domestic with foreign cements outside this region. When cement is imported by the Government or for the use of public institutions, the import duty is remitted.

Peru experienced a more rapid recovery from the depression than the neighboring countries, hence cement consumption has increased greatly. The Government has sponsored extensive highway, irrigation and harbor construction work, all of which require large quantities of cement. A substantial growth in market requirements is anticipated. A pronounced shortage of cement was reported early in 1945.

The following table presents the principal statistics of cement in Peru during recent years.

Imports[1] exports, production, and consumption of cement in Peru, 1934-43, in metric tons

Year	Imports from the U. S.	Total imports	Exports	Production	Consumption[2]	Per capita consumption, bbl.(376 lb.)
1934	193	15,140	-	45,576	60,716	0.06
1935	363	28,067	-	60,296	88,363	.08
1936	342	45,756	-	75,115	120,871	.11
1937	426	54,724	-	83,048	137,772	.13
1938	623	41,498	-	101,707	143,205	.13
1939	1,136	41,210	-	119,986	161,196	.14
1940	1,866	18,765	-	124,480	143,245	.13
1941	2,576	6,184	-	167,872	174,056	.15
1942	579	1,411	1,350	188,832	188,943	.17
1943	718	2,019	8,242	208,599	202,376	.18

[1] Data on imports from the United States, 1934-38, are United States figures of exports to Peru. Data on all imports, 1939-43, from Anuario del Comercio Exterior del Peru.

[2] Production plus imports minus exports.

Uruguay

Uruguay has two cement plants. Raw materials and fuels are not readily available; therefore the plants are relatively high cost. Nevertheless, the country consumes large quantities of cement. Following are descriptions of the plants now in operation.

1. Compañia Uruguaya de Cemento, Sayago. During 1911 and 1912 the German firm, Miag, built a one-kiln wet-process cement plant at Sayago, 7 kilometers from Montevideo. A second kiln added in 1914 increased the capacity of the plant to about 45,000 metric tons (265,000 barrels). In July 1919 the Lone Star Cement Corp. of New York, N. Y. (International Cement Corp.), purchased the plant, and it has since operated under the name "Compañia Uruguaya de Cemento." In 1929 the company added four cement storage silos each 32 feet in diameter and 80 feet in height. Their combined capacity is said to be 100,000 barrels. In 1930 four kilns were operated, and the plant had an annual capacity of about 200,000 metric tons (1,180,000 barrels). As reported in 1941, the capacity was nearly 300,000 metric tons (1,800,000 barrels). It is a well-designed wet-process plant. Originally coal was used for fuel, but later the plant was modified to use oil, which is imported from Colombia, Venezuela, or Mexico. The company is capitalized at 5,000,000 pesos (about $2,500,000) and employs 500 to 600 men.

Limestone, which is used as the principal raw material, is quarried at Minas, about 125 kilometers distant, and transported to the plant by rail. The deposit is said to be extensive. Clay is obtained near the mill, and gypsum is imported. Burlap imported from India before the war was made into bags of 50 kilos capacity at the plant. Production costs are high because fuel and raw materials must be conveyed long distances. The cements sold as Artigas and Incor brands compare favorably in quality with imported products.

2. Compañia Nacional Cemento, Neuva Cararra. The Compañia de Materiales de Construcción, manufacturers of refractory brick, stone, and other products, began construction of a cement plant in 1937. During the spring of 1939 this company was renamed the Compañia Nacional Cemento, with offices in Montevideo. The company is capitalized at 2,500,000 pesos ($1,976,000) and is backed by the Uruguayan Banco Frances Supervielle & Cia. The plant is at Nueva-Cararra, 110 kilometers east of Montevideo. The wet-process plant, for which Denmark supplied the machinery, is said to be capable of producing 40,000 metric tons of cement annually. Both gray and white cement are made, as well as supercement and lime. The plant is reported to have commenced production in July 1939.

Cement plants in Uruguay have certain monopoly privileges under the provisions of the Uruguayan law regarding the establishment of new industries in the country. The resulting high cost of cement stimulated a demand for a Government-operated plant to supply cement for Government use. In 1928 a Government cement plant was proposed under a 4,000,000-peso ($2,574,800) bond issue, but the proposal was vetoed by the President and could not be passed over his veto.

A law dated October 10, 1931, charged the State monopoly company, Administracion Nacional de Combustibles Alcohol y Portland, popularly known as

"ANCAP", with the manufacture of cement.[25] A decree established March 5, 1937, requires not only that the ANCAP shall control the prices of portland cement destined for public works, with authority to import, but also that all cement used in public works shall be acquired directly from the ANCAP except when the ANCAP is unable to supply it. Evidently this decree will not be in force until the Government plant is in operation.

On November 8, 1938, ANCAP announced a public subscription to build and equip a cement plant at Montevideo. The initial capacity of the projected plant was to be 50,000 metric tons a year, and it was intimated that later the capacity would be doubled. Limestone would be obtained from Minas, 120 kilometers from Montevideo, clay from the Rio Plata River, and fuel oil from the refinery operated by ANCAP. ANCAP awarded a 5,000-peso ($3,219) scholarship to a young engineer to make a personal study of German and United States cement plants. Apparently this plant never materialized.

The operation of a Government-owned plant had the backing of Centro de Barraqueros de Materiales de Construcción, an association of contractors, which also sought lower tariffs to encourage larger imports of foreign cement. A reduction in tariffs is opposed by the operating companies, but they would be agreeable to such change if there was a corresponding reduction in electric-power costs. The protective tariff is high (0.015 peso per kilo or about $1.28 per barrel), and imports, which were relatively small, consisted chiefly of white and other special cements. They entered through Montevideo and were shipped over Uruguay by rail or in small river boats. Railway freight rates are high.

Cement is used extensively in Uruguay, where the per capita consumption is the highest of any country in South America except Argentina. Nearly all the roads, which are said to be the best in South America, are of concrete.

The following table shows statistics of cement in Uruguay during recent years insofar as the data are available.

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[25] Willimek, Rudolf, Die Zementindustrie Uruguays: Zement, vol. 28, No. 4, January 26, 1939, pp. 57-58.
Griebner, G., Ausschreibung für den Bau einer staatlichen Zement-fabrik in Uruguay: Zement, vol. 27, No. 34, August 25, 1938, p. 522.

Imports,[1] exports, production, and consumption of cement in Uruguay, 1935-43, in metric tons

Year	Imports from the U. S.	Total imports	Exports	Production	Consumption[2]	Per capita consumption, bbl.(376 lb.)
1935	893	3,540	-	99,778	103,318	0.29
1936	640	2,059	-	111,073	113,132	.32
1937	847	18,824	-	147,773	166,597	.47
1938	320	[3]	-	[3]	[3]	-
1939	177	4,468	150	173,500	177,818	.50
1940	841	3,586	140	167,880	171,326	.48
1941	2,547	[4]1,859	-	179,066	[5]181,613	.51
1942	128	210	5,100	[3]	[3]	-
1943	335	500	9,142	[3]	[3]	-

[1] Data for imports from the United States are figures of exports from the United States to Uruguay, 1935-38 and 1941-42. Imports from the United States, 1939-40 and 1943, and total imports, 1939-43, from Anuario Estadistico and Estadistica Panamena.
[2] Production plus imports minus exports.
[3] Data not available.
[4] 10 months only.
[5] Approximate figure.

Venezuela

Limestones and clays suitable for cement manufacture are available in many localities in Venezuela, but the raw material now is of metamorphic calcareous schist. There is no record of commercial gypsum operations, but fuel oil is abundant. According to recent data the following companies operate cement plants in Venezuela.

1. Compañia Anonima Fabrica Nacional de Cemento, La Vega. According to Willimek[26] the plant built at La Vega, a suburb of Caracas, in 1907 had a capacity of 150 barrels a day, which was increased to 300 barrels a day in 1920. It began operation with a vertical kiln, which was later replaced by a 6- by 100-foot rotary kiln. The plant is now equipped with three of the latter and one 260-foot kiln and has a daily capacity of 250 metric tons. Operation has been profitable, as the protective tariff is high. Originally the tariff was 0.055 bolivar per kilo, equivalent to $2.92 per barrel, but in August 1938 it was reduced to 0.02 bolivar per kilo ($1.02 per barrel). According to report, this plant supplied less than half the nation's requirements in 1934. During 1938 the company purchased machinery in Europe to increase the plant capacity. It is said to have a capacity of 90,000 metric tons a year. The company is capitalized at 3,000,000 bolivars ($930,000). The product is sold under the trade name "Cemento Nacional."

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[26] Willimek, Rudolf, Der Stand der Zementindustrie in den Kordilleren-Staaten: Zement, vol. 27, No. 9, March 3, 1938, pp. 131-134.

The calcareous schist employed as raw material is somewhat low in calcium content. Accordingly, high-calcium outcrops of the schist are quarried and added to the principal quarry output.

2. Compañia Anonima Cemento Carabobo, Valencia. This wet-process plant is said to have a capacity of 30,000 metric tons annually. The calcareous schist used at this plant has the added disadvantage of a high magnesium content in places. Selective quarrying is necessary. No details of plant or equipment are now available.

3. Compañia Anonima Venezolana de Cimento, Barquisimeto. The plant at Barquisimato, having a capacity of 40,000 metric tons a year, began operation in November 1945.

4. Compañia Anonima Venezolana de Cemento, Maracaibo. The Maracaibo plant, which is said to have a capacity of 90,000 metric tons a year, is scheduled to begin operation in August 1946.

5. Compañia Anonima Venezolana de Cemento, Pertigalete. The plant was reported to be under construction in 1945 and is scheduled for completion about February 1947. It is designed for a capacity of 90,000 metric tons a year.

It was reported in November 1945 that a small cement plant was located at Merida and a large plant at Chichiriviche but later reports indicated that no such plants were in existence.

When the 5 plants listed are in operation the country will have a capacity of about 345,000 metric tons a year.

Other plants have been proposed at various times. Banco Industrial de Venezuela, Caracas, sponsored erection of a plant at San Cristobal costing between 3,000,000 and 4,000,000 bolivars ($930,000 and $1,240,000) in 1937. The proposed capacity was 100 metric tons a day, and construction was to begin during 1939, but no activity has been reported.

Compañia Anonima de Cemento Taos was planning in 1937 to build a plant with a capacity of 200 metric tons a day. Originally it was planned to erect the plant at Maracaibo, but later the Island of Taos in the State of Zulia was chosen. The island is said to have low transportation charges to the mainland and raw materials of first quality. A plant in such a location would also have the prospect of developing an export trade. The plans failed to materialize.

Venezolana Industrial de Oriente C. A. promoted erection of a new plant at Guanta, State of Anzoatagui, in 1941. Approval of the Government was obtained to use the Government-owned coal mines of Maricual to provide fuel. The company was unable to complete its plans for a 73,000 metric ton capacity plant.

Proposals were also made for plants in several coastal towns in the States of Anzoatequi and Falcon.

A cement shortage developed in 1941, and imports were encouraged by removal of the tariff. However imports were subject to permit from the Ministry of the Treasury. The duty-free period up to April 7, 1943, was later extended to August 7, 1943 and again extended to May 7, 1944. Moreover, a reduction in wharfage charges to a uniform scale of 6 bolivares per metric ton was made effective for 5 months from December 7, 1943.

The principal consumers of cement in Venezuela are the oil companies and the Government. It was customary in prewar days for the oil companies controlled by European capital to buy their cement in Europe and for those controlled by American capital to buy it in the United States.

The following table shows the principal statistics of cement in Venezuela during recent years.

Imports,1/ production, and consumption of cement in Venezuela, 1935-43, in metric tons

Year	Imports from the U. S.	Total imports	Production	Consumption2/	Per capita consumption, bbl. (376 lb.)
1935	13,101	3/46,500	21,811	68,311	0.12
1936	10,379	3/67,200	37,583	104,783	.18
1937	19,755	3/119,500	44,626	164,126	.28
1938	37,000	3/113,000	39,863	152,863	.26
1939	73,801	178,339	38,399	216,738	.37
1940	63,833	112,991	87,062	200,053	.34
1941	54,366	65,866	115,415	181,281	.31
1942	19,706	25,031	121,833	146,864	.25
1943	49,549	58,464	111,721	170,185	.21

1/ Figures of imports from the United States, 1935-38, are exports from the United States to Venezuela. All import data, 1939-43, from Estadistica Mercantil y Maritima.
2/ Production plus imports minus exports.
3/ Approximate figures.

CENTRAL AMERICA

British Honduras

The demand for cement in British Honduras is limited, and the country has no cement-producing industry. Before World War II, in line with Empire preferential policy, most imports originated in the United Kingdom and Canada. Imports from the United States have been increasing. For the 4-year period 1935-38, they averaged about 200 metric tons a year, and for the 6-year period 1939-44 the average was about 580 metric tons.

Costa Rica

Limestone, chalk, and clay are available as raw materials for cement manufacture in Costa Rica, but fuel would have to be imported, as domestic coal is of low grade. Gypsum likewise must be obtained from foreign sources. The country has no cement-producing industry. Although cement consumption in Costa Rica is too limited to warrant the operation of even a small plant, steps have been taken at various times to establish such an industry. Plans were made in 1920 and again in 1923, but they were fruitless. In 1934 an effort was made to interest United States capital in a project that would utilize limestone deposits near Cartago, and in 1938 there were rumors of a projected cement plant at San Jose.

Imports enter the country by way of Limon on the Atlantic coast and Puntarenas on the Pacific. Before the recent World War cement was imported chiefly from Germany, although considerable quantities were obtained in Italy, Norway, Sweden, Japan, and the United States. Although there are no import duties, a customs surcharge of 100 percent is levied on products from countries with which Costa Rica's trade balance is unfavorable by more than 50 percent.

According to official figures from Importacion Por Articulos, imports in 1942, all of which originated in the United States, totaled 18,559 metric tons. In 1943 imports were 19,315 metric tons, of which 18,278 originated in the United States. According to Bureau of Mines records, 10,070 metric tons were exported from the United States to Costa Rica in 1944.

El Salvador

Limestone deposits are available in the Departments of San Vicente, Cabanas, Chaltenango, and Santa Ana, but the country has no fuel resources and no domestic cement industry. Clay and limestone found in the extreme northwest of the Metapan area have been tested, and they have proved satisfactory for cement manufacture.[27] Cement could be made by mixing lime with volcanic ash (puzzolana), of which there is an abundant supply, but lime burning would also require importation of fuel.

Germany was the principal source of cement for the country before World War II. Imports were largest during the heavy coffee-shipping season. United States exports of cement to El Salvador during the 1930's were very small but increased greatly during later years when European sources were cut off. They reached a peak of 85,965 barrels in 1943 but dropped to less than half that quantity in 1944.

Price control and rationing of cement were established early in the war, but rationing was suspended toward the end of 1943. In consequence of wide variations in the cost of cement imported by different dealers, a dealers' pool was established in 1943 to insure a reasonable profit to all cement importers and the avoidance of losses to those whose landed costs were excessive.

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[27] Choussy, Félix, La Industria del Cemento en El Salvador: Revista Agricola Salvadoreña (San Salvador), November 1912, pp 6-8.

Imports during recent years were as follows: 1939, 13,162 metric tons; 1940, 12,615; 1941, 14,582; 1942, 5,721; and 1943, 13,939. Since 1940 most of the imports originated in the United States.

Guatemala

Limestone and clay are abundant in Guatemala. Gypsum for retarder may also be obtained from domestic sources, but the deposits near Chiquimula are so inaccessible that the gypsum is said to cost $50 a ton delivered.[28] Oil for fuel must be imported.

At one time cement clinker was imported from the United States and ground in Guatemala, but in 1897 a dry-process cement plant was built about 2-1/2 kilometers from Guatemala City. It is reported that in 1917 the company was capitalized at $250,000 and that the plant had a capacity of 40,000 barrels a year and employed 200 men. The operating company, La Fabrica Nacional de Cemento de los Señores Novella & Compania, has had considerable financial trouble and has been reorganized several times. The International Railways of Central America invested heavily in the company before 1927. In 1928 the Government granted a 10-year exemption from customs charges, except consular fees, on all imported materials required for the manufacture of cement up to 100,000 barrels a year. The exemption applied to fire brick, coal, oil, sacks, gypsum, and explosives used in quarrying. In 1939 the exemption on petroleum and explosives was renewed for 2 years, and in return the company was to furnish the Government with 200 barrels of cement per year free of charge. Furthermore, sales to the Government were subject to a 20-percent reduction in price when the cement was to be used for public works and a 10-percent reduction when it was to be used for other purposes.

It is reported that the plant was enlarged in 1933 to a capacity of 150,000 barrels a year and that between 1935 and 1937 new machinery of German origin was installed and the mill renovated.

According to a news item dated January 1945, the original 7- by 100-foot kiln has been supplemented by a new 6- and 7- by 180-foot kiln, thus increasing the capacity of the plant to 1,050 barrels a day or approximately 315,000 barrels a year. However, it was planned that when the new kiln reached full operation the original kiln would be diverted to the manufacture of lime. When this is accomplished the plant will have an estimated annual capacity of 12,000 tons of lime and 180,000 barrels (33,000 metric tons) of cement. Crushed stone, lime, and cement blocks are also produced.

The plant is large enough to supply the country with most of its requirements of gray cement although some is imported for use in coastal districts. No white cement is made. Before the recent war this variety was imported chiefly from the United States, Italy, Sweden, Germany and Belgium.

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[28] Ingenieria Nacional (Guatemala), Visita de la Asociación de Ingenieros de Guatemala a la Fabrica Nacional de Cemento, de los Señores Novella & Compania: Vol. 1, No. 19, Aug. 31, 1933, pp. 313-319.

Market demands for cement depend principally on the state of the building trades, which in turn is influenced by the prosperity of the coffee industry. Demands have increased steadily since the disastrous earthquakes of 1917. In 1943 stocks of both domestic and imported cement were so limited that they were made subject to governmental control.

According to official records, imports during recent years were as follows: 1939, 6,823 metric tons; 1940, 1,452; 1941, 515; 1942, 52; and 1943, 264. Bureau of Mines figures indicate, however, that 1,509 metric tons of cement were exported to Guatamala in 1943 and 408 tons in 1944. No data on production are available.

Honduras

Limestone and clay evidently are available in Honduras, but gypsum and suitable fuel are lacking. A concession was granted for establishment of a cement plant in 1935, but the plant did not materialize. In April 1939 a concession was granted to a nephew of the President and a son of the Minister of Education to establish a plant near Tegucigalpa, but no development is in prospect.

Imports during recent years averaged 5,200 metric tons a year, but during the fiscal year 1943-44 they increased to 11,644 tons.

Nicaragua

About 1930 small-scale production of cement was attempted by a gold-mining company in the Corinto district, but it proved to be uneconomical, and the project was abandoned. Some years ago rumors were heard of a plant to be constructed at Managua, and more recently plans were made to build a plant in the mountains near Jinotepe southeast of Managua. The projected wet-process plant was planned for a capacity of 60 metric tons a day, using charcoal for fuel.

A concession for the establishment of a cement plant was granted to Cia. National Productora de Cemento in 1940, and construction was begun at San Rafael del Sur, about 30 miles from Managua, in 1941. This wet-process plant has one oil-fired 6- by 154-foot kiln, with a daily capacity of 65 metric tons. Limestone, obtained from a nearby deposit, is conveyed to the plant in cars pushed by hand. Clay from a local deposit is transported in the same way. Gypsum for retarder is brought to the plant by truck from Dario, about 74 miles distant. Production began in a small way in September 1942, but full operation has been delayed by lack of trucks and tires. Production in 1942 totaled only 100 94-pound sacks, in 1943 it reached 1940 sacks, and in the first half of 1944, 6,448 sacks.

It is reported that most of the output up to May 1944 had been sold to the Nicaraguan Government at $1.35 a sack in part payment of a loan. Prices to nongovernmental buyers ranged from $1.84 to $1.94 a sack, depending upon the size of the order. Cement was exported for the first time in 1942. It was shipped to El Salvador, Honduras, Costa Rica and Panama.

The prewar tariff which is evidently still in effect is equivalent to 9 cents in United States currency per quintal (110 kilos), or about 15 cents a barrel, plus a surtax of 25 percent of the duty assessed. Prewar imports originated chiefly in Germany, but other European countries and the United States furnished substantial quantities. German and Swedish ships coming to Nicaragua for coffee brought cargoes of cement at very low rates. About 90 percent of the imports were received through the port of Corinto, where there were additional charges of $1.60 a ton wharfage and $3.20 a ton for custom handling, brokerage, and clearance. When freight and dealers' profits were added, the retail price ranged from $5.00 to $5.50 a barrel. If prices of domestic cement can be maintained profitably at 1944 levels, the country will be provided with a supply at substantially lower prices than in prewar days. This should encourage a marked growth in consumption, which has been quite limited due to the low purchasing power of the populace.

No data on production are available. Imports during recent years were as follows: 1939, 8,046; 1940, 7,024; 1941, 11,749; 1942, 4,825; and 1943, 3,350 metric tons. Imports from the United States during these years were as follows: 1939, 325; 1940, 3,330; 1941, 11,735; 1942, 4,799; and 1943, 1,554 metric tons. According to United States export records, 547 metric tons were shipped to Nicaragua in 1944. No export figures are available except for 1943, when 2,345 metric tons were shipped from the country.

Panama

Large deposits of limestone and clay suitable for the manufacture of cement are reported to occur in several localities in Panama, notably in the region of Pueblo Nuevo de las Sabanas, near Maria Eugenia in the Chilibre area and near Bayano at the western end of the Panamanian highway. Plans were made early in 1943 for erection of a cement plant near Maria Eugenia, but in 1944 a new site was chosen 21 miles from Colon on the main highway from Colon to Panama. The change was made because the limestone and clay deposits of the latter area are extensive and of superior quality. It was reported in 1944 that a plant with a capacity of 300 metric tons per day, or approximately 90,000 metric tons a year, was under construction by Cemento Panama, S.A., but late in 1945 the only developments reported in the press were plans for construction of $1,000,000 plant at Panama City.

Imports in years immediately preceding World War II ranged from 45,000 to 150,000 barrels a year and originated chiefly in Norway, Sweden, and Germany. The United States was at a disadvantage because freight rates on cement from northern European countries were 50 to 60 percent lower than from United States ports. Furthermore, when pearl shell, coffee, or other products were shipped from Panama to Germany, cement was taken in payment in lieu of cash. The import duty on cement, as established March 30, 1933, is 15 cents per quintal or about 26 cents per barrel.

Imports into Panama during recent years were as follows: 1939, 34,009 metric tons; 1940, 46,156; 1941, 54,599; 1942, 17,758; and 1943, 25,045. According to records of the Bureau of Mines, exports of cement to Panama, in barrels, were as follows: 1939, 66,763; 1940, 141,938; 1941, 146,126; 1942, 59,281; 1943, 139,026; and 1944, 249,371.

Panama Canal Zone

Raw materials for cement manufacture are available in the Canal Zone, but lack of fuel has discouraged establishment of a local manufacturing industry. Any movement toward construction of a plant in this area would probably be opposed by United States cement manufacturers because they furnish substantial quantities of cement for canal maintenance and repair and for other structures in the zone. Exports from the United States to the Canal Zone reached the high point of over 916,000 barrels in 1941, but dropped to 36,000 barrels in 1943 and 75,000 barrels in 1944. A small proportion of these shipments may reach points in Panama outside the Canal Zone.

WEST INDIES

Cuba

Limestone, clay, and gypsum, the raw materials necessary for cement manufacture, are abundant in Cuba.

Cement was first manufactured in Cuba by a French company in 1898. The plant, which was constructed near Habana, had a capacity of 48,000 metric tons (about 280,000 barrels) of cement a year.[29] The product, sold under the brand name "Volcan," was inferior to imported cement, and the plant was abandoned in 1921.

In 1912 or 1913 the Krupp Co. of Germany built a cement plant near Guantanamo, Oriente Province, at the opposite end of the island from the center of the present Cuban cement industry. The plant, owned by Cubans, was named "La Gloria." Evidently the equipment and methods were inadequate to make cement that could compete with the imported product, and after 1-1/2 or 2 years of operation the plant closed permanently.

The single cement plant now operating in Cuba was built by the International Cement Corp. (Lone Star Cement Corp.), of New York, N. Y., but is operated by the Cuban Portland Cement Co. (Cia Cubana de Cemento Portland), with office in Habana. It was begun in 1916, but owing to the World War it did not produce until 1918. It is at Mariel, Pinar del Rio Province, about 30 kilometers from Habana, an admirable location both as to raw materials and transportation.

Limestone, the supply of which is virtually inexhaustible, occurs on a hill adjacent to the plant, and clay is available on the same hill. The property comprises 1,350 acres. Gypsum for retarder is obtained from a deposit in Matanzas Province. It is conveyed 1-1/2 miles by aerial tramway to the railroad, by means of which it is transported to the cement plant about 70 miles away.

The plant was originally designed as a dry-process plant and was equipped with two kilns using coal for fuel. Later it was changed into a wet-process plant, and petroleum was substituted for coal. Mexican or Venezuelan crude oil is brought in by tankers. Owing to the low prices of sugar, one of the principal sources of Cuban income, the market for cement expanded little for several years. In 1924 a third kiln was constructed, and from 1925 to 1928 three additional kilns were built, making a total of six. The machinery for the plant was purchased in the United States. The increased capacity was required to meet the demands of a great public improvement program, which involved an outlay of $120,000,000 and included the famous Central Highway 705 miles long and 20.66 feet wide. From 1928 to 1930 the plant worked virtually at capacity, producing about 350,000 metric tons annually and employing about 300 men. The company has established a safety organization which is so efficient that the plant has attained a remarkably low accident rate on the basis of man-hours of employment, even during the years of maximum production.

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[29] Sociedad Cubana Ingenieros, Revista, La industria del cemento en Cuba: Vol. 4, March 1912, pp. 85-86.

The depression years hit Cuba with particular intensity, and as the public works program subsided cement sales declined greatly. A normal market of 1,000,000 barrels annually had dropped to 220,000 barrels in 1933. As the capacity of the plant was far beyond market requirements, two kilns were dismantled and shipped to a new plant being built by the same company in Brazil. The remaining four kilns appear to be adequate for all reasonable demands, even if imports should be greatly reduced.

In 1924 a warehouse with a capacity of 6,000 metric tons was built in Habana. Two steel barges holding 765 and 835 metric tons, respectively, transport the cement. The barges require 7 to 8 hours for loading and unloading and 4 to 5 hours to make the trip. In 1929 Compania Cubana de Cemento Portland built a packing plant at Nuevitas, Camaguey Province, on the north coast some 475 kilometers from Habana, where the important sugar industry consumes large quantities of cement. This packing house also supplies the needs of the entire eastern end of the island formerly supplied by imported cement. It has a capacity of 17,000 metric tons and is served by a motor barge of 1,000 tons capacity. All three company barges are equipped with Fuller-Kinyon pumps for unloading. The cement industry of Cuba has been described in some detail in the technical press.[30]

Between 1926 and 1930 steps were taken to establish a second cement plant in Cuba. Options were taken on land in 1926, and in 1929 the Atlas Portland Cement Co. purchased land on Habana Harbor. Plans were made to erect a plant, but the collapse of the cement market shortly thereafter discouraged the enterprise.

Demands for cement increased beyond the capacity of the Cuban plant during the recent war. Accordingly, in December 1942, to encourage importation, import duties were remitted for the duration of the war. However, in 1943 a tax of 12-1/2 centavos per bag of 42-1/2 kilograms was imposed on both domestic and imported cement.

Both Government and private building reached a high level of activity in 1944, in consequence of which cement deliveries were far beyond domestic production even though the cement plant was operating at capacity, and stocks were almost exhausted. The heavy demands were reflected in imports from the United States, which, from 1939 to 1942 ranged from 17,000 to 27,000 barrels a year, whereas they increased to more than 66,000 barrels in 1943 and to 384,000 barrels in 1944.

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[30] Rock Products, The Cement Industry of Cuba: Vol. 34, No. 25, Dec. 5, 1931, pp. 25-31.

Before World War II imports of gray cement originated chiefly in Belgium and white cement in the United States. Smaller quantities of gray cement came from Germany, and a low-priced, slow-setting white cement was imported in small quantities from France. The domestic industry is fostered by substantial freight rebates allowed by the Cuban Railroad. This freight differential virtually excludes foreign cement from points 40 miles or more inland from ports of entry. Cuba maintains at times a small export trade in cement with the Antilles countries.

The principal statistics of cement in Cuba during recent years are indicated in the following table.

Imports,1/ exports, production, and consumption of cement in Cuba, 1939-43, in metric tons

Year	Imports from the U. S.	Total imports	Exports	Production	Consumption2/	Per capita consumption, bbl.(376 lb.)
1939	2,801	8,536	1	127,934	136,469	0.19
1940	2,593	4,014	10	151,414	155,418	.22
1941	4,572	4,716	3,884	154.618	155,450	.22
1942	2,815	2,986	-	165,189	168,175	.24
1943	3,486	3,486	-	169,609	173,095	.25

1/ Data on imports from Comercio Exterior.
2/ Production plus imports minus exports.

Puerto Rico

Although a United States possession, Puerto Rico is an integral part of the West Indies. Raw materials for cement manufacture are abundant. A large part of the island consists of high-grade coral limestone intruded by various volcanic rocks, some of which are decomposed into high-silica and low-silica clays.

Following are descriptions of the two cement plants in Puerto Rico.

1. Puerto Rico Cement Corporation, San Juan. In 1936 construction of a cement mill was undertaken by the Puerto Rico Reconstruction Administration under the direction of the United States Department of the Interior. The site selected was Catano near San Juan. Modern United States machinery was used throughout. Originally the plant had one kiln 306 feet long and 7-1/2 feet in diameter, with an enlarged burning zone of 8-1/2 feet. It was a wet-process plant, with a capacity of about 350,000 barrels a year. Its total

cost, approximately $1,400,000, was relatively high, partly because it was constructed to resist hurricanes up to 150 miles per hour. The raw materials, limestone and clay, are quarried nearby. Oil is used for fuel. Gypsum for retarder is obtained in Nova Scotia, Canada. Operation by the Insular Government of Puerto Rico was begun in January 1939, with a production of about 1,000 barrels a day. The plant has been described by Lauer[31] and Rylander.[32] Demands for cement increased so rapidly that in 1941 the company introduced a second kiln, 8-1/2 and 10 feet in diameter and 300 feet long. The new unit began production in June 1941. It was designed to double the capacity of the plant to about 700,000 barrels of finished cement per year. Its capacity in 1944 was said to be 720,000 barrels.

2. Ponce Cement Corporation, Ponce. In 1941 construction began on a new wet-process cement plant near Ponce. It was completed and placed in operation in August 1942. It was built with local capital supplemented by a loan from the Reconstruction Finance Corporation.

Raw materials of good quality are readily available in large supply. High-grade limestone occurs in several 600-foot hills covering an area of about 150 acres. Suitable clay occurs overlying the limestone. Sand, addition of which is needed for certain types of cement, is obtainable from a nearby deposit, and iron ore, another supplementary raw material, is obtained from a deposit about 6 miles distant. Fuel oil is imported from Venezuela, and gypsum for retarder from Nova Scotia, Canada. Small local gypsum deposits have been found. Plans have been made to sell cement in Santo Domingo and to purchase gypsum, which is said to be abundant in that republic.

A second-hand, although slightly used, 9- by 180-foot kiln was purchased in the United States. It is equipped with a heat-recuperating induced-draft fan system and is oil-fired. The limestone is first reduced in a hammer mill and pulverized in a tube mill. The clinker is likewise ground in a tube mill. A Fuller-Kinyon system conveys the finished cement to storage. The kiln capacity is 1,200 barrels a day or approximately 360,000 barrels a year.

To increase the output to meet heavy military demands, a new kiln 8 feet 2 inches and 9 feet 2 inches by 324 feet was added to the plant in 1943. Its auxiliary equipment is complete and modern. The added equipment increased the plant capacity to 2,800 barrels per day, but, with increasing efficiency, the capacity was reported in 1944 to be 3,000 barrels per day, or 900,000 barrels per year.

The total capacity of the two plants is more than adequate for the peace time normal requirements of the Island, but markets will no doubt be developed in Santo Domingo, Haiti, Trinidad and other islands of the Caribbean.

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[31] Lauer, Herbert H., United States Makes Portland Cement: Rock Products, vol. 41, No. 6, June 1938, pp. 34-38, 51.

[32] Rylander, Paul N., Puerto Rico's New Cement Plant: Pit and Quarry, vol. 31, No. 1, July 1938, pp. 35-41, 84-87.

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Production, imports, and consumption in Puerto Rico during recent years are given in the following table. A striking change is to be noted from a state of dependence in large measure on foreign sources of supply in 1939 to a condition of self-sufficiency with a moderate export surplus in 1944.

Imports, exports, production (shipments), and consumption of cement in Puerto Rico, 1939-44, in barrels (376 lb.)

Year	Imports from the U. S.	Total imports	Exports	Production	Consumption[1]	Per capita consumption, bbl. (376 lb.)
1939	352,763	648,601	426	347,981	996,156	0.53
1940	676,396	754,708	6	384,242	1,138,944	.61
1941	800,860	828,428	-	465,158	1,293,586	.69
1942	158,776	158,776	1,270	629,358	786,864	.42
1943	1,841	1,841	51,553	982,087	932,375	.50
1944	2,583	2,583	123,484	990,689	869,788	.44

[1] Production plus imports minus exports.

Other West Indian Islands

Cuba and Puerto Rico, which are geographically part of the West Indian island groups, have been covered in preceding sections of this report. Consideration is also given to the cement requirements and the probabilities of cement-manufacturing industries in the following political subdivisions of the West Indian group of Islands: British West Indies (Trinidad and Tabago), French West Indies, Netherlands West Indies (Curacao), Dominican Republic, Haiti, Jamaica, Leeward Islands, Windward Islands, Barbados, the Bahamas, and Bermuda. No cement plants are in operation in this group of islands, but it was reported in December 1945 that a new plant was under construction in the Dominican Republic. The plant, which will have two rotary kilns, is being built by the Foundation Co. of New York and was said to be 75 percent complete. The cement requirements of the Republic are scarcely large enough to keep even a moderate-sized cement plant in continuous operation, but doubtless quite extensive markets could be developed throughout the West Indies.

The Dominican Republic has abundant supplies of limestone, gypsum, and clay, but no coal or oil. Imports are duty-free and are marketed chiefly in areas adjacent to Santo Domingo, San Pedro de Macoris, and Puerto Plata. Little cement is used in the interior.

Haiti has an abundance of cement raw materials but no fuels. Market demands are small, the Haitian Government being the largest importer. From 1930 to 1939 the United States lost most of this small market to Germany and Belgium. The import duty is $0.004 per gross kilo, which is equivalent to 68 cents a barrel. Imports increased greatly in 1945, reaching nearly 4,000 metric tons during April, May, and June of that year.

Trinidad and Togabo have deposits of shell limestone, and fuel oil is readily available, but the demands for cement are too small to justify establishment of a plant.

Jamaica has no cement plant but has an abundance of limestone and clay suitable for its manufacture. A small plant would supply the needs of the island, which amount to about 120,000 barrels per year. It was estimated in 1931[33] that cement could be made for 6 shillings a barrel, which is considerably below the cost of imported cement. In 1931 experts employed by the Government of Jamaica recommended construction at Port Henderson near Kingston of a wet-process plant with a capacity of 30,000 tons a year. The fuel problem was not settled, and no further steps were taken. The British Cement Manufacturing Board is said to have made further investigation of the feasibility of a local cement industry in 1941 and 1942, but no action has developed.

Before 1920 the United States furnished about 90 percent of the island's requirements, but thereafter sales declined rapidly. By 1930, 77 percent of the imports originated in the United Kingdom, which is favored by a preferential tariff. Exports from the United States to Jamaica have been small during recent years, except in 1942, when they exceeded 30,000 barrels which presumably were devoted to construction of fortifications. In 1943 they dropped to only 31 barrels and in 1944 amounted to about 3,100 barrels. The ability of United States manufacturers to reenter the market will depend largely upon tariffs and rates of exchange. Because of a shortage of building materials, including cement, construction was almost at a standstill in 1943.

The following table shows import figures during recent years for each of the non-cement-producing units of the West Indian Islands.

Imports of cement in the West Indies, 1939-43, in metric tons

Country	1939	1940	1941	1942	1943
British West Indies........ (Trinidad & Tabago)	43,752	47,680	50,289	23,037	23,064
French West Indies.........	12,497	5,389	5,744	1,727	987
Netherlands West Indies.... (Curacoa)	39,910	16,951	24,119	24,146	22,142
Dominican Republic.........	28,912	18,586	22,201	8,092	13,085
Haiti[1].....................	10,561	11,542	9,660	4,183	8,193
Jamaica......................	29,061	31,784	25,744	11,312	26,419
Leeward Islands............	2,535	1,780	[2] 2,400	[2] 2,300	(3)
Windward Islands...........	2,680	2,619	2,426	928	(3)
Barbados....................	6,869	3,852	3,278	2,433	3,524
Bahamas.....................	5,291	6,558	6,830	2,284	(3)
Bermuda.....................	[2] 1,923	[2] 2,430	[2] 2,553	[2] 1,101	1,875
Total	183,991	149,171	155,244	81,543	[4] 99,289

[1] Fiscal years.
[2] Estimated.
[3] Data not available.
[4] Incomplete.

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[33] Cement, Lime and Gravel (London), Jamaica Buys Danish Cement: Vol. 5, No. 11, September 1931, p. 332.

Exports of cement from the United States to the West Indian islands during the war period are of interest because they indicate the sudden large demands on certain islands for cement to build fortifications or for other war uses. These figures, which are shown in the following table, are in no sense indicators of future markets.

Exports of cement from the United States to the West Indies (excluding Cuba and Puerto Rico), 1939-44, in barrels

	Bahamas	Jamaica	Leeward Islands	Windward Islands	Trinidad and Tobago
1939	(a)	(a)	(a)	(a)	539
1940	(a)	(a)	(a)	(a)	13,148
1941	(a)	351	(a)	(a)	4,202
1942	9,780	37,986	755	20,100	4,669
1943	39,751	31	2,272	1,075	15,352
1944	19,635	3,107	13,688	8,150	15,840

(a) Included under Other British.

	Other British	Curacao (N.W.T.)	Dominican Republic	French	Haiti
1939	6,052	19,629	37,274	-	51,204
1940	6,923	45,584	117,920	1,474	51,414
1941	5,153	105,014	102,591	62,763	45,066
1942	3,272	122,767	48,081	31,453	18,543
1943	9,326	73,227	118,737	9,906	48,011
1944	-	82,048	233,750	64,376	31,222